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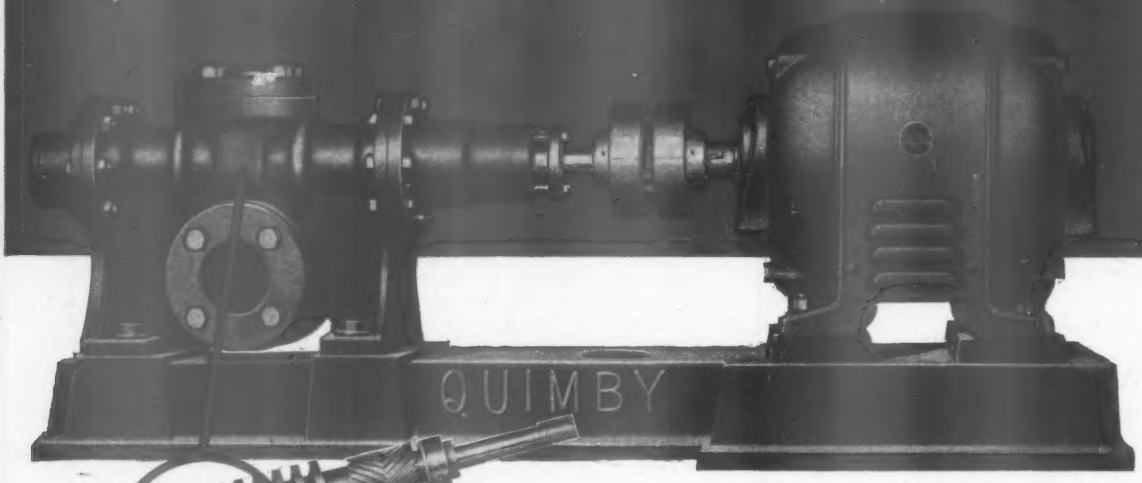

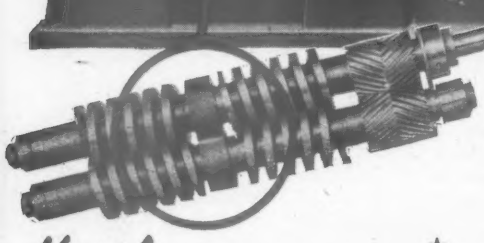

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THE OIL AND GAS JOURNAL

An Emergency Remedy

THE action of the Texas Railroad Commission in reducing that state's March allowable 353,034 bbl. daily revives a question, never satisfactorily solved before the war, as to how the oil business is to maintain a healthy supply-demand position. The adjustments made in field and plant output since the close of the war have not brought the desired balance in relation to requirements as reflected in inventories and market trends.

We have previously explained our own conviction that the permanent ending of price ceilings is basic in enabling the industry to adjust its activities to changes in operating methods and seasonal fluctuations in product consumption. Stability comes from sound long-range projections, and these are not possible when prices, the controlling factor in competitive operations, are frozen at prewar level subject only to last-minute OPA changes which come too late to remedy unwanted conditions already established.

Now the industry has moved into an emergency position. Stocks of gasoline have been too large for several weeks, and current output continues excessive. Motor-fuel prices have declined to the point where they are a threat to the entire market structure.

This was the situation that confronted the Texas Commission last week when it convened to decide what should be the output of the state which accounts for 45 per cent of the national output and a much larger percentage of the flush production. Despite the market weakness, the nominations of buyers for March totaled approximately the same as those of February.

Thus the commission had to decide whether to be guided by projected requirements or the actual market demands as estimated by the Bureau of Mines and revealed by vital statistics of the industry apparent to everyone.

This discrepancy between actual demand and buyers' nominations is not unusual. Too often it has been the rule over prolonged periods. In this instance some buyers were motivated by the fact that continued peak runs to stills were necessary if all the demands for residual and intermediate products were to be supplied.

Because of its major position in both field and refinery output, the responsibility of Texas extends through the entire industry. Prolonged excess supplies mean waste and the nullification of conservation plans which the Texas commission is bending every effort to improve and extend in both oil and gas production.

Without attempting to pass on the question of whether or not the divisions of outlets as projected for March are equitable, we do feel that the Texas officials propose to solve an emergency problem with the only practical remedy. Other conservation commissions will serve their states, their oil industries, and the nation at large by doing their part.

Texas Leads Way in Cutting Production to Offset Stock Rise

by Dahl M. Duff

A SOMEWHAT surprised Texas oil industry this week was studying probable effects of the Texas Railroad Commission's order cutting the state's daily allowable in March a total of 353,034 bbl.

Few oil men would have placed their money on such a deep slash, even though Commissioner E. O. Thompson a week earlier had served warning in a statement advocating the reduction. The cut represents about 7.5 per cent of U. S. production and about 14.5 per cent of Texas' output in February.

The same divergence of opinion that marked the allowable hearing in Austin last week was expressed over the likely effects of the order. Some believe it will make burning oils, already in short supply, even tighter. Others commend the move as relieving the flooded gasoline market where stocks continue to pile up in the face of a painfully low production of new automobiles.

In a new statement issued with the order, Thompson said that the reduced rates allow "a return to better conservation and waste prevention measures" from high production during the war when many Texas fields yielded oil "at greater rates of flow than good conservation practices would dictate." A week earlier he had pointed out that with an oversupply of crude "there is nothing to prevent the price from going down."

There were other developments in petroleum markets during the week but they were overshadowed by the far-reaching Texas allowable cut. The Office of Price Administration lifted kerosene and heating oil ceilings ¾ cent on the West Coast and again warned of a possible gasoline ceiling cut to force more production of kerosene and burning oils.

Natural gasoline, now priced at 2.75 cents in Group 3, continued unsteady.

Another drop in gasoline itself brought major quotations down to 5¼ cents for 73-75 octane in the Oklahoma Group 3 area. This reduction was a part of a general drop in prices of motor fuel products in many other sections during the week.

Gasoline stocks, after showing only a slight rise the previous week, gained 1,281,000 bbl. in the week ending February 16 but production of light and heavy fuel oils also showed a substantial increase. In New England and New York Socony-Vacuum Oil Co., Inc. made a second reduction of wholesale gasoline prices, and other distributors indicated they will follow.

The Austin allowable hearing split operators generally into two factions on the issue. On one hand were independent producers vigorously advocating a cutback and on the other were the major purchasers and some independent refiners who generally asked for continuance of the February allowable in March to fill heating-oil demand. Purchaser nominations were about the same as for February.

All Districts Reduced

In the subsequent order every producing district in Texas was reduced from the February allowable. The commission turned down requests of some operators that any reduction in West Texas be offset by a comparable increase on the Gulf Coast. The table below gives a breakdown of the reduction:

FIGURES SHOWING NET ALLOWABLE FOR MARCH, BASED ON 21 PRODUCING DAYS
(Figures in barrels daily)

District—	Net allowable as of Feb. 16	Net allowable for March based on 21 producing days	Change
1 South Central	20,993	20,115	— 878
2 Lower Gulf Coast	155,289	115,757	— 39,532
3 Upper Gulf Coast	529,939	398,424	—131,515
4 South Texas	239,117	193,007	— 46,110
5 Northeast Texas	45,443	34,430	— 11,013
6 East Texas border	104,445	95,624	— 8,821
6 East Texas field*	321,735	321,217	— 518
7-B North Central	35,942	32,033	— 3,909
7-C West Central	29,249	25,263	— 3,986
8 West Texas	514,033	425,666	— 88,367
9 North Texas	147,031	128,585	— 18,446
10 Panhandle†	95,663	95,724	+ 61
Total	2,238,879	1,885,845	—353,034

Net allowable based on 21/31	1,885,845
Est. underproduction 5 per cent	94,292
Texas crude oil	1,791,553
Bureau of Mines estimate, March	1,790,000
Texas over Bureau of Mines	1,553
Natural gasoline and distillate	171,518
Total Texas production based on 21/31 including distillate and natural gasoline	1,963,071
Texas over Bureau of Mines estimate including distillate and natural gasoline	173,071

*East Texas field on 21 days; †Panhandle field exempt.

"The Texas Railroad Commission has considered stocks of gasoline on hand which stand at 103,000,000 bbl. and stocks of crude on hand at 223,000,000 bbl. and has decided that these stocks are excessive," Thompson said. "It should be remembered that gasoline is nothing more than the finished processed crude oil, and when these 103,000,000 bbl. of gasoline are converted back into crude equivalent at 45 per cent recovery, it means more than 200,000,000 bbl. of additional crude added to the 223,000,000 bbl. in its natural state above ground. . . .

"It is impossible for us to get any nearer the Bureau of Mines figures than this because 103,356 wells are producing in Texas today. It is calculated that there is enough gasoline on hand to more than meet curent consumption even with curtailed refinery runs."

Out of the Austin hearing came three resolutions directed at the OPA. They were not passed without opposition. One, by Glenn A. McCarthy, Houston, in behalf of independent producers, asked for removal of crude-price restrictions or a raise of 58 cents a barrel in the existing ceiling. Another by Dan Hovey, Houston refiner, called for removal of ceilings on products. McCarthy's proposal failed to attract much support from major company representatives, though some of them did vote for Hovey's request for a product-price increase.

In the third resolution, offered by H. J. Porter, congressmen were asked to vote against extending the life of OPA if crude-price relief is denied.

In the give and take of the meeting, Ed Kadane, president of the North Texas Oil and Gas Association, contended refiners could make more heating oil at less profit just as producers, he said, have produced oil at cheap prices the last few years. Questioning of George Goad, representing Tide Water Associated Oil Co., brought out the fact gasoline prices have been cut 0.3 cent in the East (prior to Socony-Vacuum's latest reduction) and that crude usually dropped 25 cents a barrel when gasoline was off 1 cent. Goad, however, saw no reason for alarm in the gasoline-stock situation, but Ben Piepgrass, Bell Oil & Refining Co., objected, saying, "It's a peculiar situation when the gentlemen who want more crude say the price of gasoline hasn't been affected. It has."

Bottom-hole pressure in the East Texas field, Commissioner Olin Cul-

berson reported at the meeting, has dropped from 1,016.15 psi. January 1 to 1,015.71 psi. February 1, and daily water injections averaged 385,521 bbl. in January compared to 382,765 during February.

One of several telegrams to the commission urging the reduction was from B. A. Hardey, Shreveport, president of the Independent Petroleum Association of America, who asked the commission to lead the way for other states in cutting production back from wartime levels.

Some sentiment has been heard in other states in favor of similar reductions. The Kansas Corporation Commission was to set March demand at a hearing early this week and at the same time hear evidence on proposals to cut minimum well allowable back to the prewar level of 15 bbl. daily and to decrease acreage attributable to prorated wells to 20 acres.

Oklahoma followed the Texas pattern and reduced March daily allowable approximately 30,000 bbl. A bulk of the cut was applied to West Edmond where the per-well allowable this month will be 108 bbl. daily compared with 128 bbl. in February. Oklahoma produced 391,248 bbl. of oil daily during January, with an allowable of 390,000 bbl., according to figures of the State Conservation Department.

In authorizing the kerosene and burning-oil increase of ¾ cent on the Pacific Coast and in Hawaii, the OPA described the action as designed to produce more of these products and less gasoline, and stated "other measures will be taken, including a possible reduction of gasoline prices if the increase does not accomplish its purpose." Demand is particularly acute for special Navy fuel oil on the Pacific Coast.

Group 3 (Oklahoma) quotation on 73-75 octane gasoline is 5¼ cents—¾ cent under ceiling—and sales of gasoline as low as 4½ have been reported for several weeks. The gasoline market has been weak in the midwestern area for weeks, some attributing this to an influx of "cycle" products from Louisiana and the Texas Gulf Coast.

Oil men could find little encouragement in reports of automobile production from Detroit. Settlement of the steel strike will not be reflected on the assembly lines for at least another month, and even with settlement of the General Motors strike, volume output in the neighborhood of 100,000 units a week will not be reached until late May. Backlog of war-accumulated demand is estimated at 12,000,000 vehicles—about 3 years' production.

Service station prices, as shown in a nation-wide 50-city survey, partially reflected low gasoline prices at other levels of distribution. The average as of February 1 was 20.21 cents, 0.03 cent reduction from the 44-month low on October 1, 1945.

Net price to dealers dropped 0.08 cent to 9.99 cents. The average gasoline tax was unchanged at 6.05 cents. Service station prices last September stood at an average of 20.63 cents—highest since August 1942.

With refiners storing much gasoline without blending, natural gasoline stood at its lowest price in more than 2½ years. Competition between Oklahoma and the North Texas and Panhandle areas for reduced demand further depressed the market.

Both gasoline production and stocks spurted upward in the week ending February 16. At 105,233,000 bbl. gasoline stocks were nearing the all-time peak. A year ago stocks stood at 94,680,000 bbl. Gasoline production increased to 14,002,000 bbl. against 12,854,000 bbl. the preceding week, and 12,418,000 bbl. a year ago.

Results of the action of OPA several weeks ago in raising kerosene and burning-oil prices ½ cent throughout most of the country were seen in figures on production of these products. Light fuel oil production rose to 5,776,000 bbl. during the week, compared to 5,650,000 the preceding week and 5,240,000 bbl. a year earlier. Continued heavy demand reduced light fuel oil stocks 1,028,000 bbl. to 27,273,000 bbl. Heavy fuel oil production also gained 183,000 bbl. to a total of 8,813,000 bbl. against 8,630,000 the preceding week and 9,390,000 bbl. a year previously.

Much of the present fuel-oil shortage is blamed on heavy military diesel demands last year which prevented refiners from building up the usual stocks to meet winter civilian consumption.

In northeastern states, Socony-Vacuum's latest reduction in wholesale gasoline prices followed a previous cut by the company 10 days earlier. Tank-wagon prices to dealers in New York, Albany, and Providence were reduced 0.2 cent, and in Buffalo and Boston 0.1 cent.

New Series Starts This Week:

Modern Refining Processes

STARTING in this issue (page 60) The Oil and Gas Journal will present a series of articles describing the latest developments in petroleum refining. The series is designed to translate the numerous improvements and the new arts in refining that took place during the war period in terms of sound postwar activities. The first articles of the series will deal with peacetime applications of catalytic cracking and other processing of practical value to plant operators.

GEORGE ARMISTEAD, JR.

The series has been prepared by George Armistead, Jr., widely known operator and refinery technologist who has been associated directly with many major developments having to do with the manufacturing phases of the petroleum industry. He was asked to prepare the series by the Journal's editors after consultation with representative operators and engineers who suggested that he was best qualified to discuss present and future trends in petroleum refining covering methods, products, and economics.

Born in Houston and graduated in chemical engineering from Texas Agricultural and Mechanical College in 1923, Armistead has long been closely associated with the research and refining operations in the petroleum industry. Starting as a pipe-fitter helper with The Texas Co. at Port Arthur, he was soon transferred to the research laboratory where he worked first on one of the earliest continuous thermal-cracking pilot plants. Subsequent work at Port Arthur included fractionation, lubricating-oil distillation and treating, and the supervision of semicommercial experimental projects and included a period as assistant foreman of crude and lubricating stills.

Transferred to the Lockport Works of The Texas Co. in 1930 as technical assistant to the superintendent, Armistead was associated with the refinery operations there, including particularly the then new continuous

coking operations and thermal cracking.

In 1932 Armistead joined gasoline Products Co., Inc., licensor of thermal-cracking processes, which was sponsoring an extensive research and development program. Located in New York, he served for several years as secretary of the cracking development conference which was engaged in correlating and disseminating the results of thermal-cracking research by several associated refining and engineering companies. During this period he was also in charge of certain technical services to licensees rendered by Gasoline Products Co. including the design and operation of thermal-cracking equipment and assistance in solving operating difficulties. In this work he was also concerned with corrosion and corrosion prevention in refineries and has been an active proponent of thorough safety inspection of all refinery equipment and edited one of the first widely distributed manuals of refinery-inspection procedure.

In 1939, Armistead joined Republic Oil Refining Co. at Houston as assistant to the vice president, where he was responsible for process and mechanical design and supervised erection of the 8,800-bbl. cracking unit built by Republic at Texas City in that year. He then returned to New York with Foster Wheeler Corp. in charge of work on thermal and catalytic cracking and the construction of a modern pilot-plant laboratory and analytical facilities at Carteret, N. J.

In 1943, Armistead joined the refining division of Petroleum Administration for War in Washington in connection with the technological work of that government agency on alkylation, isomerization, catalytic cracking, and other processes involved in the 100-octane aviation - gasoline program, eventually becoming chief of the technological section which handled these activities. Since his resignation from PAW on September 15, 1945, Armistead has retained his residence in Washington and has been engaged as an independent engineering consultant in Washington, D. C. He is consultant for several corporations in the petroleum and associated industries on matters relating to engineering, operation, and economics.

Consumers Join Producers in Combating Federal Gas Control

CHICAGO.—Witness after witness paraded to the stand in the first 5 days of Federal Power Commission's hearing here to place on record their opposition to any further federal control of the natural gas industry.

Most of those testifying were consumers or public officials representing consumer states and cities. The hearing is the sixth of a series being held by FPC in what has been termed a fact-finding investigation. It is the first at which the consumer end of the question has predominated.

Natural resources belong to the people of the country and are the common property of the states, J. W. Clark, executive director of the Minnesota Resources Commission, testified. Minnesota, he said, has no desire to keep its iron production in the state borders for the use of Minnesota people.

Coal would not suffer if additional gas were brought into the state, he continued, because as the industry of the state expanded by the use of natural gas, there would be more demand for coal.

Several witnesses from Rochester, Minn., stressed the need for unrestricted use of natural gas. Gas was first used in Minnesota at Rochester. Albert J. Lobb, executive of the Mayo Clinic in Rochester, said that even though the price of natural gas be advanced to make it comparable with coal, he believed that the clinic plant would still use gas. Other witnesses pointed out the cleanliness and convenience of natural gas as a fuel.

Lee Nelson, superintendent of the municipal light plant of Rochester, asserted that the coal interests have fought gas in his city and that he doubts if they are sincere in advancing their restrictionist proposals as a conservation measure. He said he believes they are merely using this as a means of fighting competition.

One of the first witnesses at the hearing was R. Q. Selby, director of the Iowa Development Commission, who described the increasingly important role gas is playing in the state's agricultural development.

"The people of the state of Iowa have always felt that they are better able to determine their wants and needs in so far as any commodity is concerned than the representatives of a federal agency who must be far removed from intimate knowledge of conditions prevailing within the state; and they believe that any attempt on the part of any federal agency to impose such regulations is an infringement on the fundamental rights of the state and its citizens," he said. On cross-examination, he expressed belief there are no judges competent to determine what is inferior or superior use of fuel.

The hearing was enlivened during the testimony of William B. Hair, chief engineer of Rochester Daily Co. When Hair asserted he did not favor any restriction being placed on the use of gas, Richard Sache, one of the federal commissioners, asked: "Did you come here under the impression that this commission could, or would if it could, deprive you of gas?"

Preparation of Testimony

Sache had asked similar questions of previous witnesses, and when Hair said he merely wanted to present information and his attitude, Charles W. Stadell, representing various coal interests, asked who helped Hair prepare his statement and who told him that FPC might restrict end use of gas.

In the discussion that followed, Hair said gas-company people gave him an outline of what questions he might be asked and said that it was partly his own information and partly from information advanced to him by gas-industry interests that he assumed that restriction of end use was being considered.

Don H. Culton, one of the counsel for the natural-gas industry committee, asked the commission if there was anything wrong with the committee advising gas consumers interested in the proceedings that the hearing involves questions relative to end use.

He said the insinuation was that something was wrong with the industry group discussing these matters with witnesses. Nelson Lee Smith, another commissioner, told Culton he did not think his question needed an answer from the commission. Culton replied that the committee feels it is doing what the commission wishes —helping develop useful information for the investigation.

George F. Mitchell, president of Chicago District Pipeline Co., explained to the commission the necessity for heavy industrial loads in economic operation of a pipe line. "I doubt that any long-distance natural-gas pipe line now in existence would have been considered economically feasible in its inception if the gas to be transported through the line had been limited to domestic and commercial uses," he said.

"The history of natural-gas pipe lines, in general," he continued, "has been that in their development periods, they were supported in substantial degree by the sale of gas in the so-called lower-grade uses, that is, uses in other than domestic or commercial service. The natural development has been for the sale of gas to gravitate toward the higher-grade uses as rapidly as the problems incident thereto could be worked out."

THIS WEEK

PRODUCTION—Texas slashes March daily crude-oil allowable 353,034 bbl. . . . Sets pace in drive to arrest rise of gasoline stocks. . . . Some refiners protest move, claiming it impairs ability to supply fuel oil. . . . ¶Current crude production up slightly to 4,704,520 bbl. daily. . . . Output of more than 300,000 bbl. daily of natural gasoline and condensate boosts total above 5,000,000 bbl. . . .

DRILLING—Total and exploratory completions maintain margin above 1945. . . . New oil discoveries, however, are down nearly 30 per cent. . . . ¶More oil saturation reported in cores from Florida wildcat in Barnes Sound, Monroe County. . . . Slight porosity, oil saturation 10,288-10,303 ft., scattered spots black oil 10,303-19 ft. . . . Potential lime pay correlates with productive zone at Sunniland. . . . ¶Small discovery reported near Busti, N. Y.—first in area for 15 years. . . .

NATURAL GAS—Consumers add voice to protests against extension of federal authority, at Chicago FPC hearings. . . . Michigan utility commissioner seeks state control over prices, accepting FPC authority as alternate. . . . ¶Formal application filed for certificate covering 400-mile 26-in. line, Hugoton to Kansas City. . . . ¶Projects costing several million planned in Texas and Louisiana for conserving oil-field gas. . . .

PRICES—Ceilings on kerosene and heating oils raised 3/4 cent per gallon on Pacific Coast. . . . Change ties in with critical demand for more special Navy fuel. . . . Refiners will raise fuel-oil yields with incentive of higher prices to stimulate adjustment. . . . ¶OPA crude-oil advisory committee report may be released this week. . . . Recommendation expected for boost of 50 cents or more in crude-price ceiling. . . . ¶Many organizations continue efforts to remove petroleum from price control. . . . ¶Higher prices for steel almost certain to lift equipment costs, meaning crude and product ceilings will become more oppressive. . . .

REFINING—Humble Oil & Refining Co. purchases Baytown Ordnance Works for nearly 7 million dollars. . . . Original cost, $13,292,000. . . . Plant produced toluene during war, now converted to motor-fuel production. . . . Facility operated on lease basis since V-J Day. . . . ¶Runs to stills increase, gasoline stocks rise sharply. . . .

LABOR—Only 11 petroleum facilities remain under Navy jurisdiction. . . . All plants may be returned to private management this week. . . . ¶Disputes are wilting under formula of 18 per cent wage increase. . . . ¶President's wage-price plan drawing objections from labor. . . . It is considered inflationary by some, expected to up living cost 10 per cent. . . . ¶Equipment manufacturers swing back to normal operations. . . .

FOREIGN—Pressure increased for congressional examination of petroleum-import policy. . . . ¶Anglo-American oil agreement will hold Washington spotlight next week, starting March 4. . . . Michigan Senate adopts resolution urging rejection of oil treaty. . . . ¶Austria threatening to nationalize oil properties. . . .

Reminiscent of earlier days in the East Texas field is this drilling operation currently under way in downtown Kilgore. Permit for the well, John Wrather 1 T. W. Lee, was issued over 8 years ago. The derrick floor occupies the space formerly used by the service station operator's grease rack, and the mud pit, behind the pump on the left, measures approximately 10 by 20 ft. Mud flows from rig to pit, through the rear of the building

Postwar Counterpart of PIWC Declared Officially Dead

NEW YORK.—The postwar creation of a peacetime counterpart of the Petroleum Industry War Council is now officially dead, in so far as the official machinery is concerned which was set up to sound out opinion of PIWC members. Council members voted thus on the issue: 46, yes; 22, no; 2, noncommital, and 5, not heard from.

In a letter to former PIWC members, W. Alton Jones, president of Cities Service Co. and chairman of the committee organized to seek industry opinion on this subject, he said:

"In view of the fact that those favoring the proposal did not equal 75 per cent of the PIWC membership, the committee will take no further action toward creation of the new council."

Following the successful completion of government-oil industry partnership, during the war, there were opinions from many sources, including Former Petroleum Administrator Ickes, that some sort of a peacetime counterpart of PIWC should be organized "to preserve the cooperative spirit." Accordingly, the PIWC members were sounded out. Less than 75 per cent were in favor of the plan, so it was dropped.

However, industry feeling, in some sources still holds that at a future date, maybe not too far away, some government agency, or agencies — taking the cue from wartime oil industry-government relationship may seek to create a similar advisory organization.

One former PIWC member said he would not be surprised if the Army-Navy Petroleum Board seeks industry counsel and might even ask that a 25 or 50-man oil board be organized for this purpose. Another source said that he would be wary of any future government request along this line because some political factions in Washington like to set up industry advisory boards and then never seek advice. "It's been done before," he concluded, adding that the PIWC-PAW relationship was ideal—"but that was during a war." The same problems do not exist in peacetime, this informant pointed out.

But there's always the possibility that both the petroleum industry and government may run into common problems that call for joint discussion in the first few postwar years, and if so, "PIWC's enviable wartime record probably will be remembered, with a request to do it again," was the opinion of still another former PIWC member.

Text of Jones' Letter

"At the meeting on December 11, 1945, of the committee appointed for the purpose of considering and recommending a program designed to preserve the cooperative spirit of unity brought about the war, the committee determined that the plan under discussion for a postwar council should be submitted to all members of the Petroleum Industry War Council with the request that they study the plan and indicate whether they felt such a postwar council would serve a useful purpose.

"It was the sense of the committee that if at least 75 per cent of the Petroleum Industry War Council members were in favor of the plan, the committee should proceed with organization of a new council; otherwise the matter should be dropped and the committee dissolved. Accordingly a letter was addressed to all members of PIWC, transmitting the plan and requesting the members to express their opinion on its desirability.

"In all, 75 letters were sent out; 70 replies were received. Of these, 46 voted in favor of the creation of a new council, 22 voted against the proposal, and two were noncommital.

"In view of the fact that those favoring the proposal did not equal 75 per cent of the PIWC membership, the committee will take no further action toward creation of the new council. May I express to you, as a member of the committee, my appreciation for your cooperation."

Possibility of Price Relief Seen in Washington Moves

WASHINGTON.—Action being taken in several quarters in Washington this week was directed toward price relief for oil and products.

Scheduled to be released in the near future is the long-awaited report of the crude oil advisory committee of the Office of Price Administration which is expected to emphasize the need for a sizable upward adjustment in ceilings to stimulate exploration and to bring oil revenue in line with higher costs of wages and materials.

The committee headed by Charles F. Roeser, Fort Worth, began its study of OPA data last December. Reports are that an immediate 50-cent a barrel hike will be recommended with further raises later.

Ralph K. Davies, deputy petroleum administrator, meanwhile, was compiling data on the general oil-supply situation at the request of the Office of War Mobilization and Reconversion. The objective of the action was not definitely known, but the OWMR conceded that the supply situation apparently is easing particularly in heating oils.

The Independent Petroleum Association of America, which has been campaigning for abandonment of price control over oils, is to renew its plea at a House hearing this week on extension of the OPA act beyond June 30.

RFC Sells Ordnance Works To Humble for $6,948,000

WASHINGTON. — Humble Oil & Refining Co. has bought the Baytown (Tex.) Ordnance Works from Reconstruction Finance Corp. for $6,948,000.

In announcing the sale, RFC officials said it is the most expensive government plant thus far sold in Texas. The installation will be operated by Humble as a part of its Baytown refinery to improve the quality of motor fuel.

Built at a cost of $13,292,000, the 52-acre plant with its 69 buildings and 319,085 sq. ft. of floor area was operated during the war by Humble to produce toluene, and at the end of the war an interim lease contract was negotiated between Humble and the Government for continued operation pending completion of the sale. Other government units near the Humble refinery include a butyl-rubber plant and a butadiene plant, both of which are operated by the company for the Government.

Property Confiscation Feared in Patent Bill

NEW YORK.—The National Association of Manufacturers is attacking the patent priority bill pending in the House on grounds that it would result in unlawful confiscation of patent property and might become "an entering wedge to the fatal weakening of our patent system."

The bill was reported out of the House patents committee with the statement that it is designed to preclude suits by alien enemies for infringements of their patents by the United States and its contractors during the war. R. J. Dearborn, chairman of N.A.M.'s patent committee, said the measure is ambiguous and contains a provision which N.A.M. believes would confiscate for the benefit of the government bona fide patent rights legally acquired from nationals of any country from September 8, 1939, to Pearl Harbor.

Proven Reserves Estimated at 20,826,813,000 Bbl. by A.P.I.

NEW YORK. — Proven reserves of domestic crude oil at start of 1946 amounted to 20,826,813,000 bbl., an increase of 373,582,000 bbl., the American Petroleum Institute petroleum reserve committee reported here February 25. Reserves increased, the A.P.I. committee found, despite record 1945 production of 1,736,717,000 of crude oil.

New pools discovered in 1945 accounted for 419,984,000 bbl. of proven reserves while extensions to existing pools and revision of previous estimates totaled 1,690,315,000 bbl.

Production of 111,250,000 bbl. of natural gasoline and 4,820,000,000,000 cu. ft. of natural gas boosted the barrel-equivalent of petroleum production last year to 2,650,000,000 bbl.

Texas again topped all states in total proved reserves and new pools with California second and Louisiana third.

The Oil and Gas Journal's independent analysis published in the Annual Issue, January 26, credited domestic fields with proven reserves of 21,078,024,000 bbl., an increase of 563,285,000 bbl. The Journal's total included 183,706,000 bbl. of reserves in new fields discovered in 1945 and 2,091,300,000 bbl. by revisions to previous estimates and extensions to older fields.

Pauley Nomination Still Subject Of Much Acrimonious Debate

WASHINGTON.—The nomination of of Edwin W. Pauley as Undersecretary of the Navy continues to hit snags in spite of the strong support of President Truman, reiterated at his press conference this week.

Truman told his news conference that he usually backed any man he was for, when asked whether the suggestion of Senator Stewart (Dem., Tenn.) that Pauley should withdraw would change his attitude.

"Does that mean that Mr. Pauley will have your full support if he insists on fighting it out?" a reporter asked.

The president replied that when he gets behind a man he usually stays behind him.

The previous day, Stewart, in a statement released to reporters, declared that the Democratic party is "seriously split" over the nomination and that Pauley should withdraw his name "out of common decency."

"We have had one Tea Pot Dome experience in this country, and I hope we do not have another one," Stewart said. "You cannot mix oil, water, and politics.

"The Democratic party is split, seriously split, over the nomination, and Mr. Pauley is due, out of common decency, to withdraw his own name."

Pointing out that the fight had already resulted in the resignation of Harold L. Ickes as Secretary of the Interior, Stewart declared that a fight of this nature "does not do the administration and the Democratic party any good."

Meanwhile, Abe Fortas, former Undersecretary of the Interior under Ickes, told the Senate Naval Affairs Committee, which is holding the hearings on the nomination, that he recalled the conversation between Ickes and Pauley at which Pauley is alleged to have asked Ickes to withdraw the tidelands suit in return for $300,000 in campaign contributions.

These contributions, Ickes testified, were to come from California oil men who had an interest in the oil-bearing tidelands along the California coast.

Fortas told the committee that while he could remember that the suits and contributions to the Democratic party were both discussed he could not remember whether the two subjects were linked together "on a contingent basis."

Fortas took the stand after Secretary of the Navy Forrestal had testified he had agreed to the nomination of Pauley as undersecretary with the understanding that the oil man and former treasurer of the Democratic National Party, or any other appointee, would not succeed him until they had at least 6 months experience. Forrestal added that he believed that Pauley would subordinate his own interests to those of the Navy if he received confirmation.

"While my contacts with Mr. Pauley have not been frequent, I have searched my memory closely, and I can state without qualification that at no time has he brought pressure on behalf of any individual or interest so far as Navy business, contracts, or personnel are concerned," Forrestal said.

In spite of urging by Stewart and Senator Morse (Rep., Ore.) that he withdraw his name, Pauley again stated that he wants his name to go before the Senate for a vote because he is confident he will be confirmed.

Pauley's optimism, however, is not shared by Democrats at the Capitol who are in close touch with the situation on the floor of the Senate. These sources expect that at least 10, and possibly more. Democrats will vote against him. Even if he should get two or three votes on the Republican side — a distinct possibility — this still would mean an opposition total of about 45 votes.

East Texas A.P.I. Chapter Meets in Kilgore

East Texas Chapter, American Petroleum Institute, held its first meeting of the year in Kilgore February 19. Following a reception and dinner at the Kilgore Hotel, an estimated 350 members attended the meeting at the high school. A color film entitled "More Power to You" was presented by Buda Engine & Equipment Co. The principal speaker was C. O. Willson, editor, The Oil and Gas Journal.

Presiding at the meeting were newly elected officers of the chapter, headed by N. N. Jones, Humble Oil & Refining Co., chairman. The chapter's second 1946 meeting will be held in Kilgore in April.

Boise, Ida., Tops Cities In Gasoline Price Survey

NEW YORK.—Where in the United States does the city motorist pay most for a gallon of gasoline?

A nationwide 50-city survey placed Boise, Ida., high with an average price of 25 cents. At the other end of the scale were Wichita, Kan., and Chicago, with service station prices of 16.50 and 16.86, respectively.

Idaho's tax of 6 cents and transportation costs contribute to its high service station prices. In Salt Lake City, gasoline, exclusive of tax, is 18 cents, but state and federal taxes total 5.5 cents, total 23.5 cents. In Birmingham where 23.50 cents also is paid at filling stations, the total federal, city and state tax is 8.5 cents. National average of the 50 cities was 20.21 cents. St. Louis motorists would pay least in the country were it not for a 1-cent city tax.

EXPOSING A Fallacy

by Charles J. Deegan

IF there is any one thing about the petroleum industry that the general public, government officials, and military men think they know, it is that we have only some 10, 12, or 15 years' supply of oil in the United States. That theme has been harped on in Congressional hearings, reported in newspapers, magazine articles, and over the radio so often that millions of people believe it is true.

All this misunderstanding and alarm is due to one simple fact. Supply, demand, and price, in a free market, are economic forces that control the petroleum industry. The net balance of these economic forces compels the industry to operate with a raw-material inventory representing 12 to 14 years' supply.

"Proven crude-oil reserves" is a term used in our industry to describe the amount of oil at any given time known to remain underground in the oil fields. This oil supplies the backlog for the continued operation of the production branch of the industry. The public might understand us better if we used the more common business term, "raw-material inventory," for that is exactly what it is.

When we speak of 10, 12, or 15 years' supply of oil, we are talking about the industry's raw-material inventory. Compared to some industries, this is an enormous inventory. Many manufacturing industries commonly operate on a basis of 3 months' to a year's supply of raw materials in their inventory. The petroleum industry, due to its peculiar nature, normally operates on a basis of 12 to 14 years' supply of raw-material inventory. The industry's own technical jargon for this inventory is "proven reserves." Perhaps, in the interest of the public, we ought to consider changing our technical language.

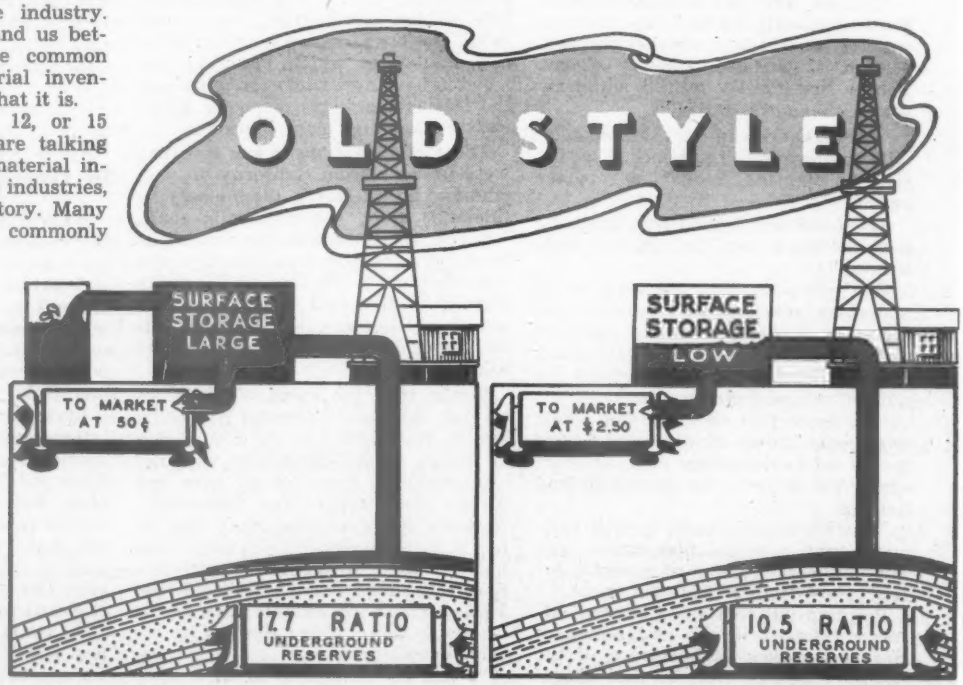
Proof that the term refers to nothing more than an inventory is easily presented. During the period 1918 to 1945, over 86 per cent of all the oil ever produced in the United States has been brought to the surface and marketed. That certainly covers enough of the industry's history to reveal how it operates.

During that 28-year period, the highest year's supply of oil was 17.7, in the year 1919; the lowest 10.4 in 1923, the 28-year average 13.6, and at the end of 1945 it was 12.3 or about 10 per cent below the 28-year average. The year's supply figure at the end of 1945 is higher than 1923, 1924, 1925, 1926, 1927, 1928, 1936, and 1937. At the end of 1945, in spite of a war fought largely on oil, in spite of wartime shortages of materials and manpower, artificial price restrictions, and other types of government control, the years' supply situation is only about 10 per cent below the 28-year average.

Inventory Principle Important

Raw-material inventory in any business, and petroleum is no exception, is something to be turned into finished products and sold to the ultimate consumer. Every merchant and manufacturer knows the principle of inventory. It must bear some relationship to the volume of business being done. Every industry has established, by trial and error, what that normal relationship must be. Over a 28-year period, the petroleum industry, by trial and error in a free market, has demonstrated that 12 to 14 years' supply of raw material inventory is about right for its operations.

On the basis of the figures on the years supply of oil, there is certainly no more occasion for public concern now that there has been at almost any time during the past 28 years. Those government officials who are so worried might take note that at no time during these 28 years have oil men displayed undue alarm over making annual investments of new capital. The men who have the most at stake in the future of the oil supply of the United States, and who have the most intimate knowledge of its operations and prospects, have



Pictogram illustrating changes that have taken place as a result of conservation practices. Aboveground storage no longer influences price, as it is reduced to status of working stock only, with main reserve underground

never hesitated to invest hundreds of millions of dollars each year to back their judgment that the petroleum industry was in pretty healthy shape with good future prospects.

The statistical proof of the meaning of years' supply is given in Table 1 and Fig. 1. Table 1, taken from data assembled by Petroleum Industry War Council, covers figures on "proven reserves" (which we ought to call "raw material inventory"), source American Petroleum Institute; "annual crude oil production," source U.S. Bureau of Mines; "years' supply," obtained by dividing the reserves by the production; and "price of crude oil," source U.S. Bureau of Mines.

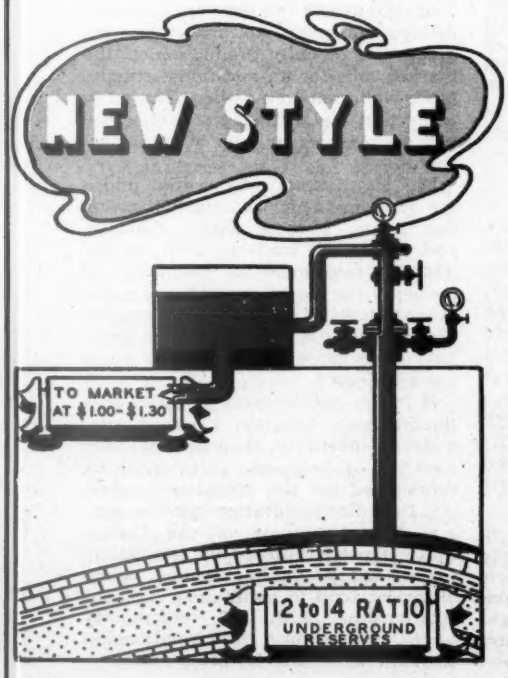
Every business man appreciates the effect of price on raw-material inventory, and vice versa. Here again the petroleum industry is no exception. Fig. 1 shows the rise and fall of the years' supply of oil (raw-material inventory) plotted with price. Those familiar with the history of the petroleum industry will find it mirrored in these two lines on the chart. The price curve illustrates the alternating periods of "boom" and "crash" between 1918 and 1927. From 1927 to 1933, the period in which conservation principles won their acceptance, the rise in years' supply (raw-material inventory) and the accompanying crash in prices is quite obvious.

The lines on the chart also reflect the modern economic era of the industry that began to take form in 1934. Down came the previously too-high years' supply (raw-material inventory), and up went the price to an existence level. Since that time, the chart shows that the swings have been less violent, but the relationship of price and years' supply is perfectly obvious. When years' supply starts up, price starts down. When the years' supply starts down, price goes up.

TABLE 1—U. S. PROVEN CRUDE OIL RESERVES, PRODUCTION, RATIO, AND PRICE. RATIO, OR "YEAR'S SUPPLY," EQUALS RESERVES DIVIDED BY PRODUCTION

Year—	Proven reserves 12/31 (per A.P.I.) (000 omitted)	Production for year[1] (000 omitted)	Year's supply	Price of crude U.S. avg.[2]
1918	6,200,000	355,928	17.4	$1.98
1919	6,700,000	378,367	17.7	2.01
1920	7,200,000	442,929	16.3	3.07
1921	7,800,000	472,183	16.5	1.73
1922	7,600,000	557,531	13.6	1.61
1923	7,600,000	732,407	10.4	1.34
1924	7,500,000	713,940	10.5	1.43
1925	8,500,000	763,743	11.1	1.68
1926	8,800,000	770,874	11.4	1.89
1927	10,500,000	901,129	11.7	1.30
1928	11,000,000	901,474	12.2	1.17
1929	13,200,000	1,007,323	13.1	1.27
1930	13,600,000	898,011	15.1	1.19
1931	13,000,000	851,081	15.3	0.65
1932	12,300,000	785,159	15.7	0.87
1933	12,000,000	905,658	13.3	0.67
1934	12,177,000	908,065	13.4	1.00
1935	12,400,000	996,596	12.4	0.98
1936	13,063,400	1,099,687	11.9	1.09
1937	15,507,268	1,279,160	12.1	1.18
1938	17,348,146	1,214,355	14.3	1.13
1939	18,483,012	1,264,982	14.6	1.02
1940	19,024,515	1,353,214	14.1	1.02
1941	19,589,296	1,402,228	14.0	1.14
1942	20,082,793	1,386,645	14.5	1.19
1943	20,064,152	1,503,176	13.3	1.20
1944	20,453,231	1,677,753	12.2	1.24
1945	*21,078,084	*1,711,721	*12.3	*1.30
Avg. for period			13.6	1.33
Total for period		27,235,297		1.08

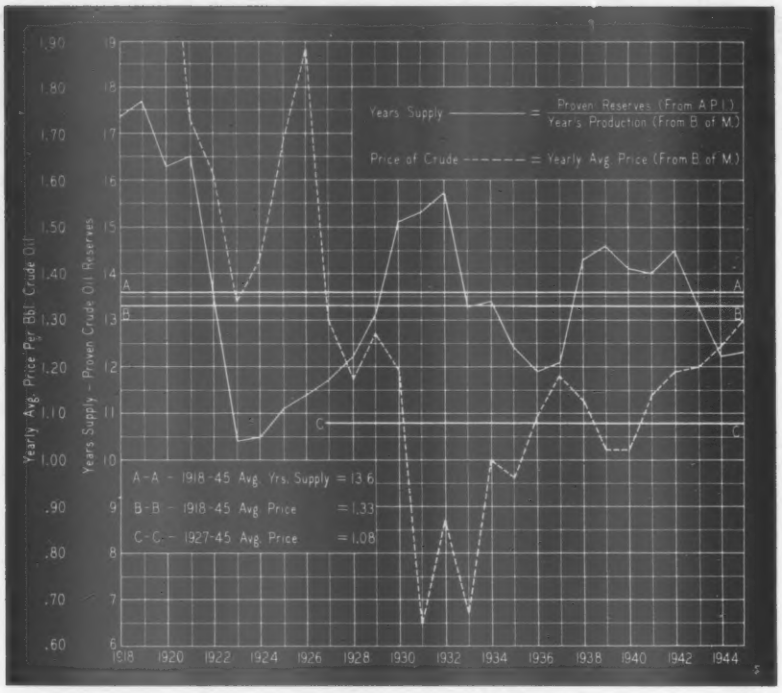
1. Bureau of Mines. 2. Bureau of Mines. *The Oil and Gas Journal.



From this chart we can tell that proven crude-oil reserves in the United States are always going to fluctuate slightly above or below a ratio of about 13½ years' supply. Within reasonable limits, we can forecast just about what the "proven crude-oil reserves" for the United States will be for any given rate of domestic production. Certainly over any normal 5-year period, proven reserves will average very close to 13.5 times the average annual domestic production.

Engineers and geologists familiar with the methods and techniques of making estimates of proven reserves in the United States will readily understand why the final answer at any given time is an economic factor. As used in the United States, the term proven reserves includes a very large amount of underground oil in areas that have been drilled, from which wells are producing oil daily. In addition, a small area, not yet drilled, but adjoining producing territory, is included, and estimates of the oil underlying this adjacent territory are made. The sum of the two makes up the grand total proven reserves.

From the nature of the methods used, it is inevitable that the answer reflects the amount of drilling that has been done, and the amount of oil that is being currently produced. The only way to estimate the future oil to be recovered from wells currently producing is to judge their future by their past and present performance. Then the estimates of additional future recoverable oil from the smaller


Years Supply = Proven Reserves (From A.P.I.) / Year's Production (From B. of M.)
Price of Crude = Yearly Avg. Price (From B. of M.)
Yearly Avg. Price Per Bbl. Crude Oil
Years Supply - Proven Crude Oil Reserves
A-A - 1918-45 Avg. Yrs. Supply = 13.6
B-B - 1918-45 Avg. Price = 1.33
C-C - 1927-45 Avg. Price = 1.08

Relationship of price to year's supply of oil

undrilled area adjacent to these producing wells must be based on the performance of the nearest wells.

Since proven reserves are a function of drilling, and drilling in turn is influenced by price of oil, it would be very strange indeed if the "proven reserves" as estimated for the United States did not turn out to be an economic matter. Therefore considering the matter solely from the standpoint of the techniques used in making estimates, the results obtained should reflect the economic condition of the industry at any given time. It has already been shown that this is what has happened. This second line of reasoning simply shows that it was perfectly logical that the first analysis should have revealed what it did.

Natural Limitations on Inventory Withdrawal Rates

In most industries, the raw-material inventory can be drawn upon at any rate that business conditions indicate desirable. The petroleum industry differs in that natural laws fix rather narrow limits to the range of rates at which the available inventory can be brought to the surface. Prior to the middle 1920s, there was little knowledge of these natural laws, and the industry accepted whatever rate of production the individual wells made naturally; with little or no effort at man-made controls.

Under these circumstances, the underground raw-material inventory had less influence on short-range price fluctuations than did variations in the above ground storage inventory. At that time "proven reserves" underground, were erroneously considered to have long-range significance for the future of the industry as a whole, but only academic interest in so far as current day-to-day problems of price, supply, and demand were concerned.

Without man-made controls, nature tended to deliver the oil to the new wells very erratically, at first in large volume, followed by rapid declines to much lower daily rates, then a "settled production" period of much slower decline rates. Aboveground stocks had to be maintained at a high level compared to the current rate of production, because of the wide fluctuations in the natural deliveries from the underground reservoirs.

Then came an intervening period of change, and accompanying confusion, lasting from the middle 20's to almost the middle 30's. A series of prolific fields brought about a flood of overproduction of oil, about the same time that engineers were learning how to control the rate of withdrawal from wells. The engineers found it was not necessary to accept nature's unrestricted rate of delivery to the well. Moreover, they found that by artificially restricting this delivery, the ultimate recovery of oil from the well would actually be increased.

During the period of confusion it was not clearly realized that in effect, engineering and conservation principles had transformed the place of aboveground crude-oil storage. From a barometer whose fluctuations were warnings to be immediately reflected in the price of crude, it was shrinking to a mere working stock function. Some aboveground working stocks were necessary to fill the pipe lines, to keep a chain of tankers moving, to afford refineries flexibility in operations. But, the major function of serving as a price barometer had now been shifted back where it had always finally rested, directly to the underground proven reserves.

Actually the underground reserves had always served as the basic raw material inventory, but lack of control of rates of withdrawal from this inventory had obscured its true relationship to price. This accounts for many of the bad guesses about price between 1917 and 1934.

The transformation of the economic function of aboveground stocks would have resulted in a serious problem for an industry expanding more slowly than petroleum. It was not without its pains and misunderstandings in the petroleum industry. But eventually a combination of some reduction in actual barrels stored above ground, plus increased working stocks required for an expanded volume of business, brought a new equilibrium.

Now that the rate of withdrawal from the underground raw-material inventory is under a substantial measure of control, and aboveground stocks have adjusted to their normal function of working stocks only, it is much easier to estimate the proper price changes necessary to adjust to any given supply and demand balance.

There is still a normal decline in the amount of oil that natural laws permit to flow into the wells from the reservoir, although the decline is slower than was the case under the uncontrolled methods of former years. Consequently it requires a continuous drilling program to maintain any given rate of daily production. If the market calls for an additional supply, more wells must be drilled. The more wells that are drilled, the higher the proven reserves will be in total barrels.

The significant thing is that under the new methods, as under the old, the natural play of supply, demand, and price, still tends to keep the industry's raw material inventory of proven reserves at around the same average level of 13 to 14 years' supply. The equilibrium point is still the same, only the wide swings of former years are eliminated.

If future public policy requires that the industry maintain a larger raw-material inventory, then a completely new set of economic rules must be established for the petroleum industry. Its entire integration into the general price economy of the United States must be altered by legislation, for as can be easily checked, crude oil prices tend to maintain a constant relationship with all commodity prices, and a very close relationship with the raw-material price index.

Industry Cheered by Prospect of Early End of Labor Disputes

THE oil industry looked uneasily this week at the near certainty of price increases in iron and steel products which are essential supplies in all phases of its operation.

Advisory committees for iron and steel and related products were meeting in Washington to determine adjustment of ceiling prices in view of the $5-a-ton raise decreed for the basic steel industry as a means of settling the recent nationwide strike.

Steel fabricators consider they have been squeezed in between the demands of their still-striking workers and the boost in the cost of their principal raw material. Oil producers contend they have been similarly squeezed between frozen prices and wage increases already granted with a materials price increase yet to come from the steel settlement.

In Washington, Office of Price Administration officials were reported studying how much the higher costs, which they figured to be about 10 per cent, can be absorbed by the fabricators. Officials were said to feel the fabricators will require "more substantial relief" than that afforded the rest of the steel industry. The series of meetings in Washington with makers of all types of iron and steel products began last week and are to continue until March 4.

Equipment Settlements Near

In Houston where steel workers struck 6 weeks ago in the demand for the 18½-cent hourly wage increase, a union official this week expressed belief an early settlement is in view at plants of both Hughes Tool Co. and Reed Roller Bit Co. The official, Charles E. Smith, said the labor negotiators are working on a counter proposal for the Reed company.

Statements of Noah Dietrich, executive vice president of Hughes, contained no indication of an immediate settlement. The company executive said production at Hughes is averaging 82 per cent of normal with 3,700 employes on the job. The basic steel increase, he said, will cost the company $300,000 a year with the company granted no corresponding increase to meet this additional expense. "We have made application for a price increase," he said, "but it has not yet been granted. Furthermore, our request does not include even the 15-cent wage increase which we have offered our employes upon their return. We cannot apply for that until the wage stabilization board grant us that wage increase, and they will not grant that until the union agrees." Smith said the union had no intention of settling for less than the announced figure.

A. F. of L. longshoremen agreed not to load cargo from the Reed and Hughes companies on a ship in the Houston port last week after striking steel workers, hearing of the impending shipment, threw a picket line around the area for 5 minutes.

Dietrich, in an earlier statement, said Hughes plans to employ fewer workers than it did before the strike. He said labor walkouts have retarded production of materials to such an extent that the drilling industry has reduced its schedule of operations. To avoid an overlarge year-end inventory, he said, Hughes may reduce its payroll by as many as 1,000.

Only 13 Properties Still Held

Within the oil industry itself, O. A. Knight, president of the C. I. O. oil workers union, predicted at his headquarters in Fort Worth that the Navy will be "out of the oil business" by the end of February. His statement appeared somewhat optimistic; as a tally early this week showed 13 properties still held by the Government out of the 53 that were seized last October.

Knight pointed to the oil workers' wage settlements which, he said, are the highest in the nation, and have been effected without raising oil prices to the consumer. Increases under the agreements, he added, are about 26 cents an hour.

Settlements, however, are proceeding rapidly. Among those added to the list returned to private management are National Refining Co., Findlay, Ohio; Standard Oil Co. (Ohio) at Cleveland and Toledo; Union Oil Co. of California, at Oleum, and Wilmington, Calif.; Republic Oil Refining Co., Texas City, Tex.; Petroleum Specialties, Inc., Flat Rock, Mich.; and The Texas Co., Lawrenceville, Ind.

Several thousand employes of Gulf Oil Corp. in the Houston area were given an additional 3 per cent pay increase supplementing an earlier 15 per cent raise. The move, officials said, does not affect the refinery at Port Arthur where negotiations are still under way with the oil workers' union.

Another pay raise was that announced for most employes of United Gas Pipe Line Co. and Union Producing Co. in the Shreveport district. Base-pay schedule was raised approximately 18 per cent to all employes on an overtime basis with the company returning to its prewar 40-hour week.

National Labor Relations Board actions affecting the industry included: an order for a collective bargaining election among Phillips Petroleum Co. employes in the Breckenridge, Tex., district gasoline department at the request of the C.I.O. oil workers' union; certification of the C.I.O. union as pursuant to an election for operating and maintenance employes of Great Lakes Pipe Line Co., and certification of Standard Oil Development Co. employes (unaffiliated) for accounting, office, and clerical workers; an order for an election among production and maintenance employes of Pasotex Pipe Line Co. for or against representation by the A. F. of L. operating engineers' union; and an order for an election among boilermaking and welding department employes of Gulf Oil Corp. at Port Arthur for the C.I.O. oil workers' union, an A. F. of L. union, or neither.

Program Chairmen Named For District Meetings

NEW YORK.—Chairmen have been chosen to head the program committees for four district meetings of the division of production, American Petroleum Institute, to be held during the next 4 months.

Program committee chairmen follow:

Pacific Coast district—M. W. Morris, Standard Oil Co. of California, meeting to be held at the Biltmore Hotel, Los Angeles, April 11-12.

Southwestern district—W. V. Vietti, The Texas Co., meeting to be held at the Washington-Youree Hotel, Shreveport, May 17-18.

Mid-Continent district—H. S. Kelly, Phillips Petroleum Co., meeting to be held at the Skirvin Hotel, Oklahoma City, June 6-7.

Eastern district—J. F. Swain, Huntley & Huntley, meeting to be held in the William Penn Hotel, Pittsburgh, June 13-14.

New Airline Will Start Oil-Area Service March 5

Continental Air Lines will start service March 5 over a new route between Tulsa and other oil centers in Oklahoma, North Texas, West Texas and New Mexico. Points to be served between Tulsa and El Paso include Oklahoma City, Wichita Falls, Lubbock, Hobbs and Carlsbad.

The route was authorized chiefly because of its benefit to oil men since it joins major producing areas with headquarters of many companies.

Unitization Is Called Key To Conservation of Gas

HOUSTON. — Wholesale unitization of leases shared in by all operators is the key to the problem of conserving flare gas.

This statement was made by Rex G. Baker, general counsel of Humble Oil & Refinery Co., at an all-day meeting here last week of oil operators and company representatives with the Texas Railroad Commission. The session was the second of four statewide conferences in which the commission is gathering facts for possible conservation regulations. Next hearing is set for March 28 at Midland.

Three basic steps are necessary, Baker emphasized, for gas conservation: (1) Produce oil scientifically so that little flare gas results; (2) find a market for gas produced, and (3) if no market is available, return the gas to the original reservoir.

As for unitization, Baker asserted conserving flare gas is a highly cooperative project which must be joined in by all landowners and operators in a pool. One company cannot go it alone while other operators in the same field pay no heed to conservation, he added.

Humble, top operator on the Texas Gulf Coast, has definite plans to spend $4,783,000 on conservation projects, in addition to more than $1,900,000 already expended by the company in the commission's District 3 largely in the Houston area. Cost of this program to Humble and cooperating companies was inadvertently reported as $58,000,000, on page 139, February 16 issue of the Journal. Actual cost to Humble and associating companies will be in excess of $8,000,000.

Waste Being Reduced

Statements made at the meeting by Baker and others indicated the extent of the flare gas already being conserved. Glenn McCarthy, Houston independent oil operator, told the commissioners the amount of gas being flared in his fields is negligible.

C. V. Millikan, Tulsa, Amerada Petroleum Corp., reported that steps under discussion by operators are directed toward conservation of the 10,000,000 cu. ft. of gas being flared in Fairbanks field, while an equal amount already is now being utilized. Stanley Gill, representing J. S. Abercrombie Co., said more than 322,000,000,000 cu. ft. has been returned to the reservoirs of the Old Ocean field since its discovery and that plans are projected by operators to utilize the remaining 3 per cent of the total gas production now being flared.

Scarcity of materials and manpower during the war has delayed plans to prevent gas venting, Baker said. Humble's plans, he continued, embrace projects designed to save 76.4 per cent of the vented gas in 11 coastal fields. These he named as follows: Amelia, Anahuac, East Clear Lake, Dickinson, Gillock, Hastings, Lovell Lake, North Katy, Redfish Reef, Tomball, and Webster. Material has been ordered or is on hand for projects in all these fields except Amelia.

In three fields, 92 per cent of the gas will be conserved by additional development now under consideration. These are, he said, Conroe, where Humble's gas production is 17,238,000 cu. ft. daily, and Thompson and South Thompson with a daily production of 4,700,000 cu. ft.

Seven fields in which Humble produces small amounts of gas but is ready to cooperate with other companies for conservation purposes were listed by Baker as Cedar Point, Hardin, Magnet-Withers, Rowan, and Segno Deep. Three others, which, he said, are uneconomical for conservation projects because of the small volume of gas or other conditions are Barber Hill, Livingston (regular, Wilcox, and Sparta sands), and Old West Columbia.

From data gathered, Olin Culberson, commissioner, said the regulatory organization will be able to determine what additional rules should be adopted on gas-oil ratios, gas lift operations, and whether additional forms and orders will be necessary for the metering of such flared gas and gas lift.

Conciliation Service in Thirty-Third Year of Settling Labor Disputes

WITH national attention centered in a relatively few industrywide strikes such as steel, many persons are apt to overlook the substantial part played by the 33-year-old United States Conciliation Service in maintaining labor-management peace.

With its seven regional offices and staff of 275 conciliators, the service has been working quietly both during the war and reconversion periods not only to settle disputes but to prevent them before they interrupt production.

To look at the record, the Conciliation Service handled nearly 26,000 cases in the 1944-45 fiscal year, including more than 5,000 strikes and threatened strikes. Of the 75,653 cases handled during the war, 76.1 per cent were settled by the service, and the remainder certified to the War Labor Board for further action.

Either management, labor or a representative of the interested public can invoke the services of a conciliator by writing, wiring or telephoning a regional director. Regional offices are in Boston, New York, Cleveland, Atlanta, Kansas City, Chicago, and San Francisco.

In general, the service offers three types of assistance to labor and management. Through conciliation, the representatives of the service attempt to dispel ill will and bring together the parties to a dispute. In other cases, the issue will be turned to an arbitrator if both sides agree to abide by his findings. A third type of service consists of technical fact-finding surveys.

The service operates under 1913 legislation which provides: The secretary of labor shall have power to act as mediator and to appoint commissioners of conciliation in labor disputes whenever in his judgment the interests of industrial peace may require it."

The difficult task of conciliation is undertaken by a commission selected for the particular case by the regional director after he has been called into the controversy.

After entering the case, the commissioner's first usual effort is directed toward attempting to remove the conference as far from the scene of the conflict as possible. He tries to bring about an informal atmosphere in which the conflicting parties can work out their own solution with the conciliator directing the progress.

The staff of the service includes commissioners with special training for arbitration hearings. Occasionally arbitrators are selected from outside the service, usually drawn from the educational or legal professions. The service's record shows that in 1,151 cases in the 1944-45 fiscal year arbitrators were appointed with nearly all awards well received by management and labor.

Interest in Mexican Settlement Case Centered on Appraisers

by Curtis Vinson

MEXICO CITY.—In the wake of the February 7 agreement between the Mexican, British, and Dutch governments to institute proceedings aimed at evaluation of and settlement for the properties of Mexican Eagle Oil Co., British-Dutch Shell company expropriated by the Mexican Government in 1938 together with various other foreign-held properties, interest has centered for the time being in the naming of the two appraisers called for by the agreement.

In the negotiations between the Mexican and U. S. Governments leading up to settlement for American properties, Morris L. Cooke represented the United States and Manuel J. Zevada represented Mexico. These two agreed on compensation figure of $23,995,991 in their award of 1942. Accepted by the two governments, this indemnity total was later accepted by the companies affected and periodic payments have since been made by Mexico.

Procedure between the Mexican, British, and Dutch Governments is expected to follow the same line as in the settlement with the U. S. companies. There is some speculation here over whether Zevada, who served in the American settlement, will be named again by the Mexican Government. Only two appraisers will be named and their findings will be final with the governments concerned. Indications here are that Mexican Eagle officials intend to cooperate wholeheartedly in effecting a settlement.

Under the agreement, the three governments have until March 7 to name the two appraisers. The following 5-month period is allowed to get the machinery of appraisal moving and the succeeding 5 months to carry on the investigation and present report to the governments concerned. The next, or twelfth, month is designated as the period to fix methods and terms of payment, provided the governments accept the report, or, in the event agreement on the report is not reached, to institute diplomatic negotiations to resolve the problem.

As indicated, the whole process is spread out over a year's time, beginning February 7. It is felt generally in oil circles here that the procedure will move along smoothly as all governments concerned are reportedly anxious to have problem disposed of.

The Mexican Eagle properties represented the largest single holding in the Mexican oil industry at the time of expropriation. At the time (March 18, 1938), this company had a daily production of around 105,000 bbl. daily, the largest total in any one field being 45,000 bbl. daily from Poza Rica. Other production was in the Golden Lane and Ridge areas and in the Isthmus where production was some 30,000 bbl. daily.

At the time of expropriation, Mexican Eagle controlled some 65 to 70 per cent of the rich Poza Rica field where it was only just getting into full-stride production. Brought into production in 1933, Poza Rica to date has yielded something like 250,000,000 bbl. of oil.

In addition to its production Mexican Eagle had three refineries, a 60,000-bbl.-daily-throughput plant at Tampico, a 30,000-bbl. plant at Minatitlan, and a 17,000-bbl. plant at Mexico City (Atzcapotzalco).

Dividend payments by the Mexican Eagle in 1937, final year prior to expropriation, indicated some 40,000 shareholders in the company. Shareholders of British nationality represented approximately 75 per cent of the total at the time, reliable estimates indicate.

Sun Oil Plans $4,000,000 Gas Utilization Program

PHILADELPHIA.—Nine processing plants, either under construction or contemplated, which will cost about $4,000,000 and result in conserving more than 65,000,000 cu. ft. of gas daily have been outlined by Sun Oil Co.

The plants, the principal projects on which Sun is planning construction immediately, will be located in Texas, Louisiana and Michigan. In addition, the company is planning to gather and sell 5,000,000 to 6,000,000 cu. ft. daily of flare gas in the Beaumont area.

Construction of a natural gasoline, and possibly a gas storage compressor plant, in the Sun and North Sun fields in South Texas is scheduled. The installation will involve an expenditure of about $1,000,000 and will handle 10,000,000 to 12,000,000 cu. ft. daily. It may be expanded later to process additional gas from nearby fields, according to James E. Pew, manager of the natural-gas department.

Sun is also joining with other operators in South Texas in the construction of a gas cycling and natural-gasoline plant in the Seeligson field to handle 40,000,000 cu. ft. of gas and cycle 150,000,000 cu. ft. of gas-condensate. The company's investment in this project will approximate slightly more than $2,000,000.

Already under construction in South Texas are two of four small pressure-maintenance plants costing about $165,000 and designed to conserve from 3,000,000 to 5,000,000 cu. ft. of gas daily.

In Louisiana, plans are going forward for a natural-gasoline plant in Delhi where 8,000,000 cu. ft. daily will be gathered and processed. In Michigan, a pressure maintenance plant costing about $125,000 will be built soon to handle 3,000,000 to 3,500,000 cu. ft. daily of casinghead gas.

Spurrier Is Director of New Mexico Commission

ALBUQUERQUE. — A 1940 New Mexico School of Mines graduate in petroleum engineering, R. R. Spurrier, has become the new director of New Mexico's Oil and Gas Conservation Commission and state geologist.

R. R. SPURRIER

Spurrier, who succeeds John M. Kelly, entered the Army in February 1941 as a quartermaster corps private. He won a commission in the Corps of Engineers and was released last October with the rank of captain after receiving the Purple Heart.

Supplementing his education, he worked in oil fields in Ohio, Oklahoma, and New Mexico for several companies.

Rollins Becomes Officer Of Atlantic Refining Co.

Richard Rollins, who has been with the Atlantic Refining Co. for 26 years, is now getting acquainted with new duties as company secretary. He retains his title as director of public relations. William M. O'Connor, who died recently, was secretary prior to Rollins' appointment.

RICHARD ROLLINS

After serving with the Army in World War I, Rollins joined Atlantic and was sent to Paris in 1920 as assistant general manager of foreign marketing. Later he was named general European representative. In 1934 he returned to Philadelphia and became assistant secretary and director of public relations.

INTERNATIONAL

Venezuela Gives More Security Confirmation

Further assurance that the rights of foreign oil companies operating in Venezuela will be respected fully by the revolutionary government currently in power was brought to this country by Luis Herrera F., former director of the Technical Bureau of Hydrocarbons, Ministry of Development. Herrera visited Tulsa this week in his current inspection trip of the oil operating centers of the United States preparatory to starting his new work as assistant to the president of Mene Grande Oil Co., Venezuelan affiliate of Gulf Oil Corp.

"The president (of the junta revolutionary government) emphatically stated and authorized me to convey this message to all interested parties," Herrera said, "that the junta will respect in its entirety the rights acquired by the oil companies operating in Venezuela. These companies will in no way be hindered in developing their activities and the present government looks favorably upon the investment of foreign capital which contributes to the economic progress of the country."

The president's views and the policy authorized for expression by Herrera were voiced when the latter conferred with the chief executive when the director of the technical bureau resigned that post.

Drilling to Be Resumed In Dominican Republic

NEW YORK.—Dominican Seaboard Oil Co. will open its search for oil in the Dominican Republic with a resumption of drilling operations expected soon. Drilling has been held up nearly a year awaiting results of further seismograph and geologic study. Dominican Seaboard, an affiliate of Standard Oil Co. (N. J.), was the first to make seismograph surveys in the republic and when drilling is resumed will be the only company conducting drilling operations there.

Mexico's Production Goal Set at 160,000 Bbl. Daily

MEXICO CITY.—Expansion of the Mexican oil industry, aiming at a daily 1946 production 42,000 bbl. a day greater than last year and including several refining and pipe line projects, is planned by Petroleos Mexicanos, the official company.

Pemex hopes discovery of wells of greater and more sustained production will step up daily crude production to 160,000 bbl. as compared to 103,900 bbl. in 1944 and 118,000 bbl. last year. More exports, both of crude and refined products, are sought, but officials emphasize the domestic market will not suffer.

Revenue from domestic oil sales is expected to increase to a total of 430,000,000 pesos. While this is greater than 1944's total of 332,000,000 pesos, it still would be substantially under 1943 figure of 992,000,000 pesos.

G.A.C. Opens Agency In New York

NEW YORK.—With the recent announcement of a New York agency of Groupement D'Achat des Carburants, known as "G.A.C." the French Petroleum Agency, two French oil men were concurrently named director and assistant director.

Etienne L. Dalemont, who was associated with Societe Anonyme des Petroles Jupiter (Shell) when it was organized in 1941, in Paris, is the director, with Marcel R. Thomas, who was connected with Standard Francaise des Petroles (Jersey Standard) for 15 years as head of the lubricating coordination office, as assistant director.

Dalemont served for a year in the French army and is a graduate of the Paris School of Mines. He also studied economics at the University of London and for a period handled work for the economics intelligence section of the London Mission of the French Ministry of Industrial Production. In Paris he was later in charge of obtaining substitute fuel for a 6-month period during the war. On joining G.A.C., Dalemont handled economics and financial problems.

After serving in the French army, Thomas, from 1941-45, was assistant manager, then manager of Comite de Coordination des Lubrifiants, an organization which handled all problems concerning the supply, manufacture, and distribution of lubricants for France. He is a graduate of Institute de Chimie de Paris.

G.A.C.'s full title is Groupement D'Achat des Carburants, Combustibles Liquides, Lubrifiants & Derives. This association, comprised of oil companies operating in France, replaces the Petroleum Section of the French Government Mission of the Ministry of Industrial Production, which heretofore worked out of London and Washington.

Edmund L. Wilson is controller and Malcolm Beranger is consultant.

E. L. DALEMONT

M. R. THOMAS

Two Rigs Assigned to North Spain Exploration

NEW YORK. — Purchase of two drilling rigs for exploratory work in the Pyrenees area of northern Spain was confirmed here this week by a spokesman for Socony-Vacuum Oil Co., who added that Socony has also employed two national geologists for this project.

Southwestern France has two comparatively new oil and gas-producing areas. At Saint Marcet, about 100 miles north of the Spanish border, in Haute Garonne Province, the wholly owned French Government oil company, Regie Autonome des Petroles, is developing part of a 600,000-acre concession on which about 10 wells are now producing some oil and considerable gas. Saint Marcet receives all its gas from this area.

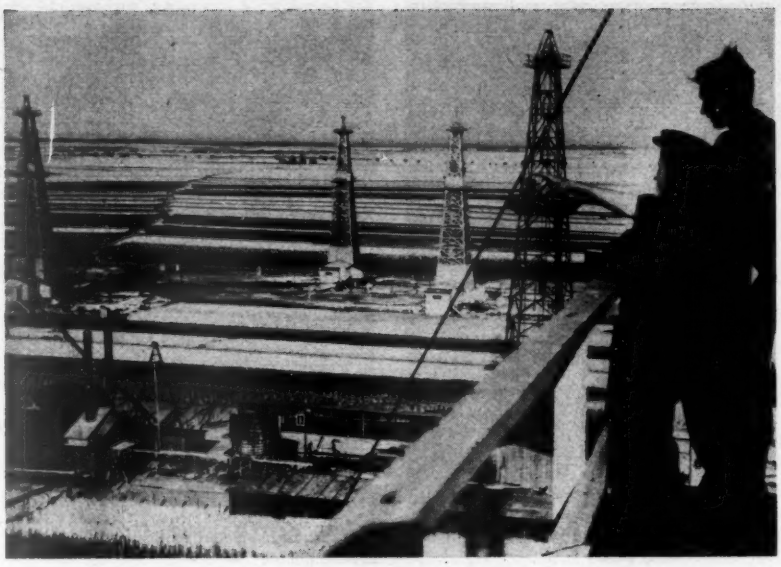
Another French company (owned 55 per cent by government and 45 per cent by private interests) is active in south France. Societe Nationale des Petroles D'Aquitaine owns its concession near Montpellier, about 200 miles north of the Pyrenees, where about 15 producing wells have been completed.

Venezuela Tectonic Map Completed by Bucher

NEW YORK. — A tectonic map showing the first complete charting of Venezuela's principal oil-bearing structures, has just been completed as the result of 4-months' work, according to Prof. Walter H. Bucher, Columbia University geologist. Copies are expected to be available in a couple of months.

Professor Bucher, working at the invitation of Venezuelan officials, gathered his material through the cooperation of oil companies which have holdings in Venezuela. He was assisted in the field by Victor M. Lopez, director of the "Servicio Tecnico de Mineria y Geologia." The map also reveals the rock formation of the entire country.

It is expected that the map will be published in this country in cooperation with the Geological Society of America.



Field at Zistersdorf (formerly Austria) now disputed by Allies

Concern Felt That Austria May Seize Oil, Industrial Properties

by Warren W. Burns

NEW YORK.—Will Austria's provisional Renner government follow Czechoslovakia's nationalizational program and attempt to take over that country's petroleum and other industrial properties?

This is the question that continues to plague United States and British foreign interests with land and property in that country. And the question becomes particularly poignant with the "Russian-Austrian oil trust" in control of operations there. Following Russia's 50-50 participation in all branches of Hungary's economy, and its ensuing complications, foreign interests continue to wonder what Austria's government will do next.

Right now the Allied Decentralization Committee (composed of representatives from the United States, Great Britain, France, and Russia) is endeavoring to establish a basis whereby prewar ownership of industries and companies can be attained. But, as indicated in the February 2 story on Austria, in the Journal, this committee is not meeting with too much success in that a four-power conference—presumably on a higher and on a political level—is scheduled for the near future, with the express purpose of determining what constitutes Nazi-owned assets in this area.

To date, Russia has held that under the Potsdam agreement she is entitled to all property in eastern Austria, and so far has chosen to disregard more the fact that she is signatory to two declarations, the essence of which is that Russia and the other Allies were fully aware of Nazi tactics of "legally" transferring foreign properties either to German or Austrian nationals, and that steps would be taken to remedy this wartime development.

If American and British interests, which had prewar holdings in Austria, agreed to current suggestions that cash be paid certain Russian-controlled German interests for United States and British properties which rightfully belong to them, the Soviets would, authoritative sources state, also insist that charges for all drilling operations—done largely by the Germans—be paid for as well.

Nazis Exploited Production

Austrian production, during the war, zoomed under Nazi direction, but it is known that the wells were allowed to flow at an excessive rate—following the discovery of a number of productive formations in the Zistersdorf and nearby fields—with the result that the yields from many wells suffered a sharp decline. Moreover, when—and if—United States and British interests regain their properties, the only areas that will not have been explored or exploited are the land fringes where it is generally believed that production possibilities are practically negligible.

And while not taking a too pessimistic view of the Austrian oil situation, some sources report that "at least" we hope to build up a large market there for good-quality lube oils and specialty petroleum products. In fact, surplus lube oils, from Army stocks in Europe, are now being sold in Austria where the civilian market is quick to absorb them, not having been able to obtain them during the entire course of the war.

Stocks of gasoline and fuel oil, in Austria, are said to be particularly high at present, with all storage filled to capacity. Some wells already has been shut in as a result.

Another reason given for the sudden end-of-the-war decline in Austria's production is the fact that the German drilling equipment sent to Austria operated only about 3 months without maintenance, while the prewar American equipment was good for approximately a year without any attention given to this vital phase of operations. The Nazi lack of adequate and good steel, for drilling purposes, resulted in the consequent lack of maintenance parts.

Companies responsible for the initial production in Austria's oil industry were: Rohoel-Gewinnungs A.G., jointly owned by Socony-Vacuum and the Royal Dutch-Shell group; Erdolproduktions-Gesellschaft M.B.H., established by Swiss interests; Raky-Danubia, an Austro-German venture, and Van Sickle, a British operator. When the Nazis occupied Austria in 1938, they changed the country's petroleum law, squeezing out the U. S. and British interests.

Col. James R. Rundell, of the U. S. Army, is this country's representative on the Allied Decentralization Committee, with the Russian general the representative for Russia. The high rank of the Russian representative is indicative, an authoritative source points out, of the importance which the Soviets attach to this "fact-finding panel."

In a February 19 dispatch from Vienna, New York Times Correspondent John MacCormac says:

"Russia, having obtained a half-nelson on Hungary's economy by including the Hungarian Government to sign the '50-50' treaty and by taking over control of the Lispe oil fields, is now increasing the pressure on the Austrian Government, apparently with the same end in view. She has requested Chancellor Leopold Figl's government to make available for the feeding of the Russian occupation forces 70,000 acres in lower Austria and Burgenland. She has dismissed virtually all the Austrian officials of the Zistersdorf oil companies and replaced them by Russian engineers charged with increasing the output of the field for Russian ends to a point that Austrian engineers and some foreign owners of these companies consider highly wasteful."

H. F. Beardmore, newly elected chairman, petroleum division, A.I.M.E.

Carlton Beal, secretary-treasurer, and author of technical paper

M. L. Haider, elected member of the executive committee

Varied, Lively Program Features A.I.M.E. Petroleum Division Meeting

by Charles J. Deegan

CHICAGO.—The opening of the first annual meeting of the American Institute of Mining and Metallurgical Engineers held outside New York in 35 years, found the petroleum division taking an active and aggressive part, with a program that started Sunday, February 24, and continued through Thursday.

In the mineral industry education division, the Sunday evening session was devoted entirely to petroleum, under the guidance of Harry H. Power, chairman, and Harold Vance, associate chairman. The program consisted of a talk on "Petroleum Economics" from the educational standpoint by Lester C. Uren, University of California, followed by "The Role of Geology in Petroleum Engineering Curricula," by R. E. Sherril, University of Pittsburgh; "Petroleum Engineering Education in Venezuela," by Santiago E. Vera I., Central University, Caracas; "Petroleum Engineering Education and the Quantitative Approach," by Harry H. Power, University of Texas, and "Undergraduate and Graduate Requirements of Thermodynamics," by Donald L. Katz, University of Michigan. Following the formal presentations, there was an active round-table discussion of reservoir engineering, and the thermodynamics of oil and gas mixtures.

On Monday there was a formal registration, and it was obvious that the attendance was going to be large in the petroleum division, with indications that the Texas delegation would be the largest, and the other Mid-Continent oil-producing states well represented. A general committee meeting of the petroleum division was held in the afternoon, with large attendance and the business affairs and future plans of the division were the subject of lively discussion and some debate.

The article starting on page 44 of this issue, "Exposing a Fallacy," covers part of the paper delivered before the economics session by Charles J. Deegan, associate editor of the Journal who spoke before the A.I.M.E. on "United States Proven Reserves versus Price." Part 2 of the A.I.M.E. paper deals with Department of Labor statistics, showing the relationship between the general commodity index and the price for crude oil with Bureau of Labor data converted from the conventional 1926 base to a 1935-1939 period.

Tuesday morning the reservoir engineers had a session, M. L. Haider and C. V. Millikan presiding, with the presentation of Carlton Beal's paper, "The Viscosity of Water, Gas, and Gas-Saturated Crude Oil Under Reservoir Conditions." This was followed by an important paper on "Interpretation of Well-Test Data in Gas-Condensate Reservoirs," by J. O. Lewis, who was also awarded the Lucas medal this year. This paper posed some problems regarding the difficulties in reconciling the theoretical answers on the performance of retrograde-condensate reservoirs with the data obtained in field tests. In general the paper and the ensuing discussion brought out the fact that sufficient operating experience and data are now available to point up weak spots in fields sampling methods, and possibly certain weaknesses in the theoretical conclusions about future reservoir performance derived from laboratory tests. Further attention by both field operating engineers and laboratory men is needed to solve these problems.

The reservoir-engineering session was concluded with two important papers, one, "Performance on Bottom Water Drives," by M. Muskat, and the other, "Some Experiments on the Mobility of Interstitial Water," by R. G. Russell, F. Morgan, and M. Muskat. Discussion of all papers was lively and the general interest indicated there is no slackening in the trend of engineers to consider the reservoir as a whole as the subject of most importance now and for the next few years.

The Tuesday afternoon session, with H. F. Beardmore and K. A. Covell presiding, heard an interesting paper on "Reduction of Sulfates in Oil-Field Waters," by F. B. Plummer and I. W. Walling; a paper on the technique of "Gravel Packing of Oil Wells," by Thomas S. West; and an exercise in "imagineering" by Henry Emmett Gross on "The Possibilities and Problems of Drilling Beyond the Continental Shelves." With drilling in up to 100 ft. of water known to be practical, and the further fact that engi-

neers of some of the major companies are known to have devoted some thought to very deep-water drilling problems, this paper did not seem too fanciful to the engineers present, regardless of how it might strike the general public.

On Tuesday evening the petroleum division had its annual dinner, with a large attendance and much renewing of old acquaintanceship among many of the members who had not seen each other during the war years. After dinner, the members heard a thought-provoking paper on the "Industrial Possibilities of Atomic Energy," by E. R. Gilliland, professor of chemical engineering, Massachusetts Institute of Technology.

The Wednesday session was devoted to the usual annual reviews of domestic and foreign production. The various oil-producing states were discussed in a total of 19 papers, of which as might be expected, Texas with 8 papers devoted to its various sections, took the lion's share of attention and discussion.

The session on the annual review of foreign production was significant of the growing importance of production in other countries. Countries covered were Arabia and Bahrein, by J. Terry Duce; Brazil, by S. Froes Abreu; Canada, by G. S. Hume; Colombia, by O. C. Wheeler; Egypt, by El Hanafy El Sayed Bey; Ecuador, by B. F. Zwick; Iran, by C. A. P. Southwell; Iraq, by Iraq Petroleum Co.; Mexico, by J. M. de la Garza Cardenas; Peru, by O. C. Wheeler, and Venezuela, by D. B. Williams.

Economic Factors Pondered

One definition of the difference between pure science and applied technology has it that the pure scientist ignores the economic factors involved in his problems, while the technologist or engineer finds the economic angles are always important, and frequently controlling. The petroleum division evidently followed this definition, for the entire Thursday session was devoted to papers on economic problems.

With Dr. John D. Gill and Brad Mills presiding, papers were presented on "The Trend in Costs of Replacing Petroleum Reserves" by James V. Brown; "U. S. Crude Reserves vs. Price," by this writer; "Economic Pattern of Oil Pipe Lines," by G. L. Shanks; "Prudent Investment in the Petroleum Industry," by J. D. Gill and A. B. Stainton; "Correlation of Drilling with Production Requirements," by Brad Mills, and "Trends in Relative Foreign and Domestic Petroleum Operations."

Out of these papers and the discussion that followed, it developed that many seemingly technological problems were primarily economic in their fundamentals. In some cases advanced technology had rendered older economic practices obsolete, but this was no reason for condemning the practices followed prior to the period when technological advances had been made. In other cases, technologically possible achievements now await only suitable economic conditions, before being put into effect.

In summary these papers brought out the fact that most of the criticisms of the industry by outsiders are based on fallacies, incomplete knowledge and understanding, and in some instances by plain lack of common sense.

Beardmore Elected Chairman

In the election of officers, H. F. Beardmore, Barnsdall Oil Co., Tulsa, was elected chairman. C. R. Hocott, Humble Oil & Refining Co., Houston, was elected associate chairman, and the two regional chairmen are Charles B. Carpenter, Bureau of Mines, Dallas, and Charles H. Keplinger, Shell Oil Co., Inc., Centralia, Ill. Carlton Beal, Jr., Richfield Oil Corp., Los Angeles, was named secretary-treasurer. Members of the executive committee include Beardmore, Hocott, Beal, M. L. Haider, Standard Oil Co. (N.J.), and H. H. Kaveler, Phillips Petroleum Co., Bartlesville, Okla.

Chairmen of standing committees follow: Kaveler (papers and programs); John S. Bell, Humble Oil & Refining Co., Tyler, Tex. (production engineering); Gail F. Moulton, Chase National Bank, New York, (production statistics); John D. Gill, Atlantic Refining Co., Philadelphia, (economics); John E. Sherborne, Union Oil Co., Santa Fe Springs, (engineering research); Walter Miller, Continental Oil Co., Ponca City, Okla., (refinery engineering); Donald L. Katz, University of Michigan, Ann Arbor, (education); Paul Weaver, Gulf Oil Corp., Houston, (geophysics); Edgar Kraus, Atlantic Refining Co., Dallas, (production geology); Alfred W. Waddill, Houston Oil Field Materials Co., Houston, (membership).

The general committee of the petroleum division authorized for submission to the national A.I.M.E. a proposal by the southern California section to organize a separate petroleum chapter. More than 400 members of the proposed California chapter would work with the petroleum division.

A.I.M.E. ABSTRACTS

Of Papers Presented at Petroleum Division Meeting at Chicago, February 24-28

Possibilities and Problems Of Drilling Beyond the Continental Shelves

HENRY EMMETT GROSS

MUCH attention is being given the problem of developing petroleum beneath the open sea. Geophysical surveys have been made 27 miles offshore from the continental United States, and once offshore ownership is established, it is likely that there will be drilling for oil on the continental shelves.

One hundred fathoms (600 ft.) quite well defines the outer limits of the continental shelves, and is thought to have been the maximum extent of land during glacial times. Beyond this is the talus slope, where has been gathered the continental debris, and it drops off quite steeply to the ocean floor, which for the most part is 2 to 3 miles deep.

The abysmal ocean is probably underlain by a thick sedimentary veneer, and it is believed that oil-bearing sedimentaries might be found beneath the deep-water areas. The great geosynclinal areas are thought to be the most favorable places for accumulation of petroleum. These include the area east of the North American Cordillera and the probable sediments in the bottom of the Gulf of Mexico and beneath the deep waters of the great Malayan Archipelago. Other less extensive areas of landlocked deep-water basins may also prove attractive.

Since the restricted deep-water portions of the hydrosphere might contain oil in commercial quantities, it is pertinent that the possibilities and problems of drilling beyond the continental shelves be set forth. These are:

1. Ocean transportation is available to deep-water drilling sites, and extensive pipe lines and roads are unnecessary.

2. Freedom from jungle pests and tropical diseases.

3. Competitive drilling less likely.

4. Extensive areas attractive for development are not yet under lease or concession.

Disadvantages are great and numerous:

1. Storm hazards from wind and wave.

2. Expensive foundations, either rigid or floating.

3. Shutdown times because of weather not permitting operations.

4. Marine regulations of federal bureaus in addition to customary regulations on land.

5. Frequent difficulty in moving men and materials to and from drilling platforms.

6. Extra precautions required in open sea.

For drilling in water over 500 or 600 ft. deep rigid foundations become too costly and floating foundations must be used. These must meet specific requirements such as the following: (1) derrick floor and well head must be in the open air; (2) conductor pipe, casing, and drill pipe when in use must be under constant tension and not undulating with the waves; (3) derrick floor and drilling platform must maintain a constant level even when loading and unloading material, and must not rise and fall with the waves at any time; (4) foundations must be of the open type in that part of the structure is subject to action of wind and wave; (5) drilling platform must remain in a fixed position at all times and must have provided means for overcoming torsion imposed by the drilling operation; (6) foundation must handle all loads amply; (7) conditions should be such that the floating

foundation can not overturn, and (8) anchors must not drag.

Recent and rapid improvements of helicopters, meteorology, radio, and landing craft will add greatly to the safety of crews working with open-water drilling and production equipment.

In conclusion, it must be conceded there are probably oil deposits under water 1 mile or more deep and that these might contribute valuable petroleum supplies where production is waning. Even though drilling in deep water may not open commercially exploitable petroleum deposits, it is pertinent to the welfare of the nation that everything possible be learned of the nature of the lithosphere beneath the deep hydrosphere.

Some Practical Aspects of Radioactivity Well Logging

WARREN J. JACKSON, and JOHN L. P. CAMPBELL, The Lane Wells Co., Dallas.

MANY operators have made use of the radioactivity well log, or are acquainted with at least one of the applications, but it is unlikely that any one operator is familiar with all of the many applications that are possible.

This paper presents a representative example of each of the many applications, wherever the information has been released by the operator, and illustrates by hypothetical examples, other applications, releases for which have not been given. In this way it is hoped that a better understanding of the scope of this new engineering tool may be obtained.

The paper cites examples of use for the following purposes: bottom water shutoff; plugging back to upper pay; finding formation suitable for salt-water disposal; locating formation from which fresh water supply is known to be available; reducing gas-oil ratios; locating zones of porosity; selection of zones for gun perforation to secure maximum oil production; securing data for relative permeability profile in limestone; determination of cement placement; squeeze cementing; plastic squeeze; structural correlation on shale; emergency logging; logging in salt-water muds; logging in oil-base drilling fluid; logging in case of threatening blowout; locating casing seat for bottom-water shutoff; clarifying doubtful measurements; and locating casing collar.

The Viscosity of Air, Water, Natural Gas, Crude Oil and Gas-Saturated Crude Oil at Oil Field Temperatures and Pressures

CARLTON BEAL, Consulting Petroleum Engineer, Los Angeles, Calif.

THIS paper presents useful charts for conversion of various viscosimeter units into centipoise and graphically summarizes published investigations of the viscosity of air, water and natural gas at high temperatures and pressures. Air, water and natural gas are considered because they are produced with, or used to produce crude oil. All terms in the report are converted to units used commonly in oil field work. Where possible, charts and correlations were constructed to cover a range of temperature and pressure encountered in oil fields. Correlation charts for the purpose of predicting crude oil viscosity and solubility behavior at oil field temperatures and pressures were constructed from an analysis of 1,332 viscosity and solubility observations from 953 crude oil samples taken from 747 oil fields. Of these fields, 501 were in the United States, including 75 in California. Of the 1,332 observations, 1,215 were viscosity values, including 786 of gas-free crude oil, 351 of oil saturated with gas and 78 undersaturated with gas at pressures above the bubble point.

Interpretation of Well Test Data In Gas-Condensate Fields

JAMES O. LEWIS, Consulting Petroleum Geologist and Engineer, Houston.

THE operation of gas-condensate fields is comparatively new and involves physical principles with which the industry was not previously familiar. It has been necessary to devise methods for testing gas-condensate wells and to correlate field with laboratory data. In this paper new methods are advanced for interpreting well g.p.m. tests whereby dilution by dry gas can be estimated and information supplied on revaporization of condensates by dry gas. Inaccuracies in well-test data are discussed.

Changes in flow rates can cause changes in g.p.m. of the effluent and it takes some time for a well to become stabilized after an important change in flow rate. Retrograde tests as usually conducted cannot be directly compared with field g.p.m. data because the tests usually include solution gas in the condensates which are reported on the cumulative basis, whereas field data usually reports pentanes plus on a rate or instantaneous basis.

There also is uncertainty whether retrograde behavior in the reservoir follows flash or differential separation, or something between the two, and whether comparison should be made with bottom hole flowing or static, or some intermediate pressure.

The cumulative retrograde test data can readily be computed to a rate basis which shows that the change from retrograde to normal vaporization is more abrupt, occurs at a lower value and at a higher pressure, than indicated by the usual cumulative curve. The rate curve also indicates that at low pressures the g.p.m. may become higher than the original content.

Both laboratory and field data indicate the possibility that the rate curve may perhaps fundamentally follow logarithmic functions in both the normal and retrograde region. This would provide a useful tool for checking the reliability of data if found to be true.

It is suspected that the concave type of retrograde curves may be due to obtaining samples from unstabilized wells. Attempts to check laboratory retrograde losses by field data were unsatisfactory because of the inaccuracy of field data and because the two sets of data were for condensates of different composition. However, it is evident that the loss for one group of shallow wells producing a lean gas had been greater than could be accounted for by retrograde tests. Comparisons for other field data were inconclusive. The need for more reliable field data and for retrograde tests on a comparable basis is apparent.

Economic Pattern of Oil Pipe Lines

G. L. SHANKS, Pure Oil Co.

SLIGHTLY over three fourths of the industry's pipe lines (on a mileage basis) are regulated as common carriers by the Interstate Commerce Commission and are required to report financial and operating data yearly. Therefore a review of these data should indicate economic trends representative of the entire oil-pipe-line industry.

Unit revenue is declining toward unit total expense at such an alarming rate that two important questions arise. What is the possible trend of unit revenue? Will the total expense unit ever rise to a point equal to the revenue unit, and if so, when? The declining differential between the two units can be arrested in only two ways, either by an increase in tariff rates, or by a decrease in the total expense unit.

Tariff rates probably will not be increased appreciably in the near future. Government policy and natural competition both seem to be against that. It would seem equally probable that rates will not decrease much more, either. It is possible, however, that the barrel/mile load for the industry may drop somewhat in the next few years, until reconversion is complete.

Lowering the total expense unit remains, therefore, as the main hope against over-all (statistical) bankruptcy in the near future. There is more hope in this direction than there is in getting enough increase in tariff rates. Better pipe and equipment, more efficient pumping practice, improvement in batching technique, higher operating pressures, more and better inhibitors and reduction in corrosion loss are some of the items now being intensively studied by alert pipeline managements. It stands to reason that so much study and effort must bring forth some fruitful results.

The effect of increasingly heavy taxation in modern costs is strikingly shown by the tax share of total expense. In 1929 it was 11.96 cents of the cost dollar, whereas in 1944 it was 29.30 cents. This 144 per cent increase in the tax zone can be seen to be the strongest factor in keeping total cost up. Postwar tax policy may alleviate this somewhat but not much.

Power, fuel, etc., have been steady throughout the 16 years in question and this trend can be expected to continue. They should even decrease somewhat, due to technological improvements.

The overall trend of labor during the 16 years is slightly downward, due to the sharply increased volume handled, but during the past 8 years it has been quite steady. With the present tendency for all wages to rise, it seems likely that this trend will shortly start upwards.

Summing up, it appears that the industry has entered a critical period in regard to its unit differential between revenue and cost, and that to avoid a crisis in solvency, extraordinary efforts are needed to: (1) increase tariff rates, if possible; (2) reduce costs by every conceivable method; (3) remove the objectionable feature of the "consent decree" by which excess earnings over 7 per cent of value are presently prevented from being "plowed back" into the value base.

Geophysical Activities in 1945

C. A. HEILAND, President Heiland Research Corp., Professor Geophysics, Colorado School of Mines.

THE upward trend in geophysical oil exploration (in the U. S.) which prevailed during the first 3 war years continued sharply into the first 4 months of 1945, then leveled off with a slight drop toward the end of the year.

Total U. S. petroleum industry outlay in 1945 for geophysical work is estimated at about $55,000,000, divided as follows:

Type of instrument	1945 Avg. No. crews	1944 Avg. No. crews	% increase over 1944	Approx. yearly cost
Seismograph	361	302	20	$39,000,000
Gravimeter	172	126	36	9,000,000
Magnetometer et al	29	23	26	1,000,000
Tub-total	562	451	25	$49,000,000
Electric well logging				6,000,000
Grand total				$55,000,000

Estimated per cent well completions logged electrically

1941	1942	1943	1944	1945
37%	43%	57%	64%	74%

Extensive activities in the Eastern Seaboard and Eastern Gulf states reported last year, are again worth noting. A further increase took place in seismic and gravimeter work in the Rocky Mountain states, extending into Alberta, Saskatchewan, and as far north as Norman Wells in Canada, and at Cape Simpson, Alaska (U. S. Navy).

Foreign geophysical work—mostly in the Caribbean and South America, increased nearly 50 per cent by comparison with 1944, with an average of about 60 seismic, 30 gravimeter, and some geochemical and magnetometer parties reported. The Texas, Creole, Sinclair, Socony-Vacuum, and Atlantic oil companies, among others, continued or enlarged their exploration programs in Venezuela, while in Colombia, continued high or increased activities were reported by the Shell, Texas, Tropical, Gulf, Socony-Vacuum, and Richmond oil companies. Various parties operated in Cuba, Trinidad, Ecuador, the Dominican Republic, Brazil, Argentina, Paraguay, and Chile, and on the other side of the world, in Saudi Arabia and Egypt. Russian operations in the "Second Baku" field were highly successful with geophysical discoveries in the Syzran and Saratov areas; as many as 25 electrical and 30 seismic parties have been in this district at one time. Additional structures were found in the St. Marcet field in southern France; and refraction methods were highly successful in the Eakring field, Nottinghamshire, England, where gravimeter surveys also were used late in 1945.

Among noteworthy technical developments were improvements in underwater gravimeters, construction of an underwater magnetometer, and of a submersible tank for gravimeter and operator, and improvements in shallow water gravimeter technique by the use of tripods to 18 ft. depth (Standard Oil Co. of New Jersey), revival of refraction technique (1) with continuous profiling features and applications in North Carolina, New Mexico, West Texas, Western Oklahoma, Southern Florida, and Ecuador, and (2) in the form of "arc" mapping in England; further uses of the fluorographic and "surface-temperature" (12-75 ft.) methods of exploration; and applications of electrolytic model techniques (S. J. Pirson) to the study of the effects of topography, water table, and permeability-anisotropy upon observed hydrocarbon leakage patterns.

Michigan Senate Calls For Rejection of Oil Treaty

LANSING.—The U. S. Senate is asked to refuse ratification of the pending Anglo-American oil treaty in a resolution passed unanimously by the Michigan State Senate.

Danger of a system of international cartels, abrogation of the state's constitutional powers by treaty, and the subordination of state authority to regulation through future action of Congress and by an international petroleum commission were cited in the Michigan resolution. Copies were sent to members of the U. S. Senate foreign relations committee and Michigan senators.

Wartime Research Features Compact Meeting Program

Wartime developments in industrial research will be featured in the program of the Interstate Oil Compact Commission's spring meeting in Tulsa April 11-13 with the principal address to be given by Dr. E. R. Weidlein, director of the Mellon Institute.

Compact committees will meet April 11 and make formal reports at a public session the next day. Also on the program for April 11 is another "Little Town Hall meeting" open to the public and conducted by committee members and industry representatives.

Dr. Weidlein, who in 1935 was awarded the Chemical Industry Medal and in 1936 elected president of the American Chemical Society, will speak April 11 at a public session.

Final plans for the 3-day meeting, which will be held at the Mayo Hotel, will be made by the compact's executive committee March 9 in Oklahoma City.

New Interior Secretary Expert in Power Field

WASHINGTON, D. C.—Julius Albert Krug, whose appointment as secretary of the interior was announced February 26 by President Truman, has devoted practically his entire business life to the public-utility field and has not been associated with any phase of oil operations. His last public office was that of chairman of War Production Board which position he resigned to engage in business-consultant work with headquarters in New York City. He is described by President Truman as a "very able administrator." His work with the Government in various capacities has been generally commended.

Krug was born in Madison, Wis., November 23, 1907, and graduated from the state university there with Bachelor of Arts degree in 1929 and a Master of Arts degree in 1930. His first position was that of research statistician of Wisconsin Telephone Co. Later for 3 years he was connected with Wisconsin Public Service Commission.

During 1936-1937 he was public-utilities expert with Federal Communication Commission and then became technical director of Kentucky Public Service Commission. During 1938-1940 he was chief power engineer of Tennessee Valley Authority and was made manager of power in 1940. He was then appointed chief power consultant of Office of Production Management and later became vice-chairman of War Production Board. During part of the war he served as a Navy officer in Washington and was with the Navy when he was appointed chairman of WPB in August 1944.

Chemical Engineers to Meet

BARTLESVILLE.—Oklahoma's tax structure and the Southwest's freight rates and their effect on the oil industry will be discussed by L. D. Melton, manager of the research and statistics department of the Tulsa Chamber of Commerce, at a meeting of the Oklahoma Chemical Engineering Society at 7 p. m., March 8, in the Jane Phillips sorority room in Bartlesville.

DEATHS

Burtwin L. Brinton, 74, oil producer of Bradford, Pa., died February 18 in Buffalo, N. Y.

Charles G. Laskey, 67, Shreveport, independent oil producer, died February 22 in New Orleans. A native of Toledo, Laskey built the first gas pipe line in northwestern Louisiana. In 1928 he was elected president of Southwest Gas Utilities Corp. Several years ago, he sold his interest in the company. He was active in American Petroleum Institute and as Louisiana director of Independent Petroleum Association of America.

J. Howard Courtner, 40, assistant general manager of Dowell, Inc., Tulsa, died February 22 in Chicago.

Charles R. Dutton, 69, pioneer Ohio oil operator, died February 23 in Corpus Christi.

John J. Brown, 73, chairman of the boards of Foster Wheeler Corp. and Foster Wheeler, Ltd., died in New York February 15.

James M. Henderson, 42, associated with Arkansas Fuel Oil Co. for the last 16 years, died February 21 in Shreveport.

William G. McGrath, for 31 years employed in the electrical department of the Bayway refinery of Standard Oil Co. of New Jersey, died February 17 in Elizabeth, N. J.

Craig T. Gardner, drilling contractor, died February 18 in Dallas.

James F. Enright, 52, drilling contractor well known in eastern Kansas, died February 18 in Wichita.

Sidney Hernstadt, president of Gilmer Oil Co. and associated with Healdton field development since its early days, died February 18 in Ardmore, Okla. Hernstadt was known both as an oil man and as a philanthropist who gave to charities and individuals.

George P. Dickey, 58, president of Dickey Oil & Refining Co. who held extensive interests in Kansas fields, died February 20 in Denver.

I. J. Killough, 77, former oil and gas supervisor of the Texas Railroad Commission, died February 18 in Eastland, Tex. For 14 years he was in charge of the commission's district office when it was located in Eastland.

David A. Smith, 90, early-day Texas drilling contractor who at one time worked for Silver Dime Oil Co. in the Spindletop area, died February 20 in Houston. He retired from the oil business in 1919.

1. Catalytic Cracking for Production of Motor Gasoline

by George Armistead, Jr.

CATALYTIC cracking is new and expensive, facing heavy competition from older processes for making much the same products. Catalytic cracking must pay off in its high quality of motor or aviation fuel produced, improved quality of cycle or residual stocks, and the efficiency of operation on high-sulfur stocks. "Bottleneck" in most catalytic units is their carbon-burning capacity. The charging of heavy liquid stocks to catalytic units will tend to force this process into fields now held by thermal or other existing processes.

THE far-reaching importance of the war-built catalytic-cracking capacity on present trends in the petroleum industry is well recognized. Since the end of the war, there has been intensified discussion of its economic and technical aspects in the press and before various bodies, which discussions have been chiefly concerned with the immediate and ultimate utility of the equipment and the effect of its use on the competitive positions of refiners generally. The oil industry of the United States is now provided with catalytic-cracking equipment totaling about 1,100,000 bbl. per calendar day nominal feed capacity, with corresponding production capacity between 500,000 and 600,000 bbl. per calendar day of catalytic-cracked motor gasoline. This feed capacity is approximately 25 per cent of current crude runs and the cracked gasoline capacity is around 65-75 per cent of the maximum peacetime production of thermal-cracked motor gasoline. Studies have been made of the industry-wide effect of utilizing this capacity for motor gasoline, including the publications of Moore and Elder[2] and Barnard and Forrester.[3] While there is indication that the distribution of the existing catalytic-cracking capacity as well as other factors may favor additional installations, and that improved processing, particularly in the smaller capacities, is now available, the operation of the present units will control the immediate and most of long-range effect of this catalytic capacity on the industry. It is the object herein to discuss certain important process and economic factors in the use of individual catalytic-cracking units of existing types for the production of motor gasoline.

The primary advantages of catalytic over thermal cracking are generally recognized to be:

1. High quality level of the cracked motor gasoline.
2. Reduced degradation of feed stock to gas and residuals.
3. Adaptability to high-sulfur feed stocks.
4. Increased gasoline yields from heavy feed stocks.

The effect of these is to increase attainable octane levels and/or decrease leading costs and reforming severity, to increase the possible ultimate gasoline yield and recovery of higher value distillate fuels, and to reduce the cost of desulfurization of products, which in aggregate are highly important economic advantages. Balanced against these advantages is the higher direct operating cost of catalytic cracking at the present time, compared to thermal cracking. The net result in some refining situations shows great economic advantage for the use of catalytic cracking in place of thermal while in others the advantage is comparatively small. One important factor in the comparison is the prevailing octane level of gasoline being marketed and with increase in this, the comparative advantage of catalytic cracking naturally increases. The over-all economics of catalytic vs. thermal cracking have been calculated by Noll and Bowles[21] who show that for their assumed conditions the net refinery return on Mid-Continent crude, before fixed charges, is always greater with catalytic than with thermal cracking throughout a motor gasoline octane range from 76 to 81 A.S.T.M. Other economic studies and data have been published by The M. W. Kellogg Co.[16] and by Anderson and Sterba.[18]

In considering the use of catalytic capacity for the production of motor gasoline, it is necessary to consider the inherent operating limitations of the equipment involved and how they relate to the economic and other factors which control refinery processing. Although individual pieces of equipment and refinery situations differ, there are several basic features and limitations common to all, which are the principal factors in determining utility. It is desirable first to review briefly the several catalytic processes now in use. It should be noted that Hydroforming is omitted as, while a catalytic conversion operation, the considerations governing its use as a catalytic reformer are somewhat different from those of the processes converting heavier oil to motor fuel.

Processes

The three widely used catalytic-cracking processes, in order of their amount of installed capacity are the Fluid, Thermofor, and Houdry. In addition, there is one unit of the Cycloversion process in use. Schematic flow diagrams of the first three processes are shown in Fig. 1-1.

The Fluid process employs the so-called "fluidized" principle whereby a finely divided catalyst is maintained in an air or vapor suspension whose properties approximate those of a fluid. The process employs a reaction zone for contacting hydrocarbon vapors and catalyst and a separate regeneration zone where the deposited coke is burned from the catalyst. The motive power for the transfer of catalyst from reaction to regeneration zones and return, is generally furnished by the air required for regeneration. Effluent vapors from both reactor and regenerator pass first through cyclone separators for removal of most of the entrained cata-

lyst. Catalyst remaining in the oil vapors going to the fractionator is collected in a heavy condensate and returned to the reactor. Likewise, catalyst entrained from the regenerator is removed from the flue gas by a cyclone separator and a Cottrell precipitator and returned to the system. Heat generated in the regenerator may be utilized to the maximum extent in heating of feed to the reactor, which reduces the additional heating requirements and requires no heat absorption facilities in the regenerator. The operating principles of the process have been widely described.[8 10 18 19]

The Thermofor process likewise employs separate reaction and coke-burning zones, the latter being known as the kiln. This process uses a pelleted or bead catalyst of between 0.1 and 0.2 in. maximum dimensions. The kiln is provided with heat-transfer surface for the removal of a substantial part of the heat liberated in the burning of coke, by the generation of steam. Transfer of catalyst from reaction and regeneration zones and return is effected by elevators. Feed to the reactors in present practice is provided by flashing the desired gas oil cut from a reduced crude or similar stock and superheating the vapor to the temperature necessary for the reactor temperature level after utilizing the residual heat in the returning catalyst. Because of the large particle size of the catalyst, its entrainment in flue gases or vapor is no problem. An elutriator is provided for the controlled elimination of the fines that gradually form from the catalyst. This process has been described in detail in the literature.[1 5 6]

The Houdry process employs the static bed, as distinguished from the two moving-bed processes previously mentioned, that is, the catalyst vessels or "cases" are used alternately for the flow of vapors and of combustion air for burning off the coke deposited during the vapor flow. For the removal of heat liberated during the regeneration part of the cycle, a large amount of cooling surface is provided in the shape of finned tubes containing a circulating molten salt mixture through which the liberated heat is used for the generation of steam. Vapor is generally supplied to the reactor after a primary flash followed by superheating to the desired temperature. The reaction part of the cycle may operate under elevated pressures up to approximately 75 psig. The flue gases from the burning of coke in the cases are used for turbine drive to supply power for the compression of air being supplied to them. The Houdry process was the first of the commercial catalytic-cracking processes mentioned here and the only one with extensive pre-war experience in the production of motor gasoline. It has been described in the literature since 1938.[13 14]

The Cycloversion process is a static-bed process differing from the Houdry in having no heat-transfer surface in the reactors, the excess heat liberated in the burning cycle being absorbed by steam or other inert gas introduced with the combustion air. It has been described by Schulze and Helmars[18]. This process employs bauxite as the catalyst and since its present scope of use is small compared to the others, it will be considered only by implication in the following discussion.

The general limitations applying to catalytic-cracking units may be classified as follows:

1. Reaction limitations.
2. Carbon burning limitations.
3. Feed preheat and other preparation equipment limitations.
4. Light ends and product fractionation limitations.
5. Limitations on sulfur content of feed.

The evaluation of these factors for any specific unit naturally requires extensive study, and it is intended here to point only to general trends.

The reaction limitations will be of varying importance in the several processes. If it is economic to process the maximum feed, possibly including recycle, limiting reactor velocities or space rate may ultimately be controlling. It is conceded that the Fluid process, with powdered catalysts, will experience marked increase in catalyst carry-over from the reactor above certain velocities, although Murphree et al[19] indicate that for many of the fluid units this effect may be offset by the increasing pressure associated with high-pressure regenerator operations. The Thermofor process experiences "boiling" above a certain reactor velocity.[1] As to space rate, per se, it is unlikely that this will be a general limitation in view of the higher

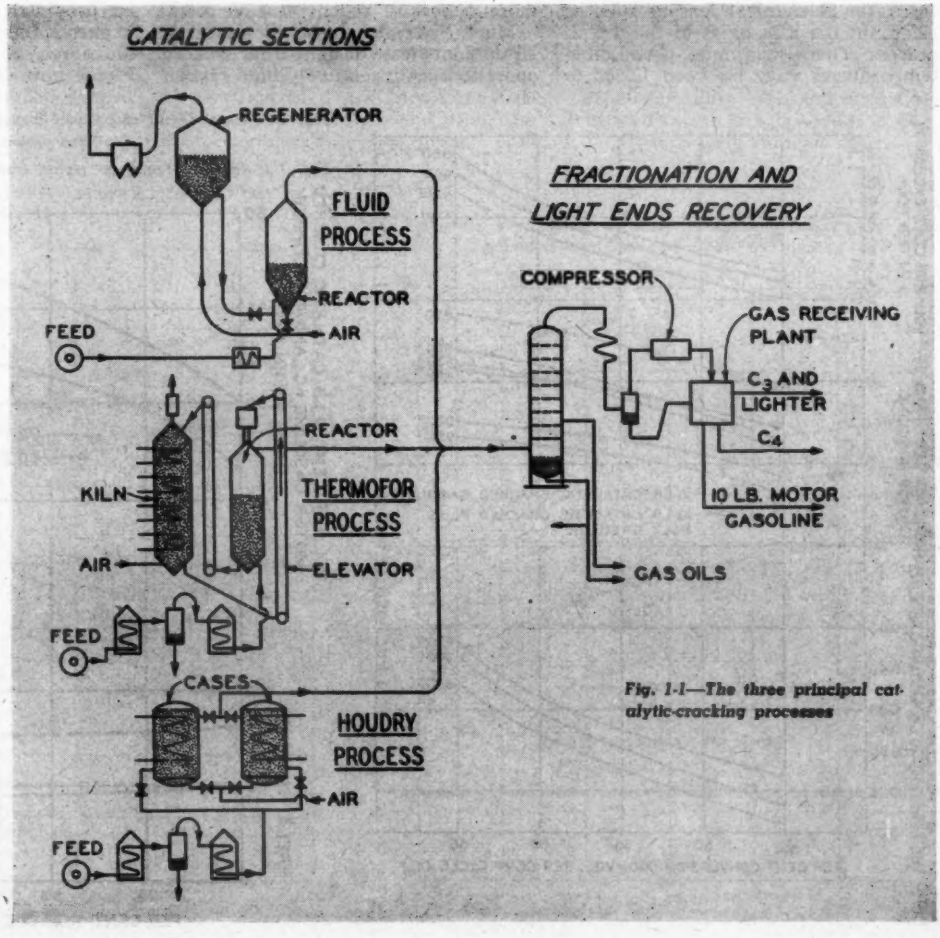


Fig. 1-1—The three principal catalytic-cracking processes

severity provided in plants designed for wartime service which will not be required for motor gasoline, and limitations to throughput in the reaction part of the system will therefore be chiefly mechanical. The efficiency of stripping of hydrocarbons from the catalyst after reaction is reflected in the total carbon-burning requirements in regeneration, as has been discussed by Newton et al[1] for the T.C.C. process, and Murphree et al[19] for the Fluid process. It is pointed out in the latter that in the case of carbon burning limiting, substantial capacity increases can be achieved through improved stripping. The effectiveness of the stripper and requirements of stripping stream also have an effect on the regeneration gas volume in the Fluid and T.C.C. processes, as a result of the carryover of adsorbed water, which in the case of natural catalyst can be an important factor.

Carbon Burning

Carbon burning is the most important limitation to all types of catalytic cracking. In the burning of the carbonaceous deposit from the pellets, particles, or beads, it is necessary to limit the temperature reached by the catalyst, for the preservation of its structure and activity, and in some cases, for mechanical reasons such as effect on the kiln parts in the T.C.C. process. These maximum permissible temperatures vary between 1,050° to 1,150° F. depending chiefly upon the process, the type of catalyst, and the partial pressure of steam present. Should maximum temperature be localized, due to channeling, for example, it may then limit the whole burning operation. The relationship between regeneration temperature and the carbon production and burning limitations in the Fluid process has been discussed in detail by Murphree et al.[19] It is pointed out that a rise from 1,050° to 1,150° F. regenerator temperature permits a reduction of about 15 per cent in carbon formation due to decreased catalyst-oil ratio while at the same time some 30 per cent gain in carbon-burning capacity results. In the Fluid process there is, as in the reactor, a limit to the regenerator velocity beyond which a marked increase in catalyst carryover will result and this may consequently limit the combustion air supply and over-all burning rate. It is possible, however, to control this regenerator velocity to some extent by raising pressure on that vessel, which has been widely done on plants limited by carbon. The ultimate limitation on carbon burning in existing units of Houdry and T.C.C. processes is the rate of heat removal through the cooling tubes, whereas in the Fluid process with powdered catalyst, it is more generally regenerator velocity.

Much of the catalytic-cracking equipment was designed for severe operations with relatively high carbon production for aviation gasoline and/or butylenes. Motor-gasoline operations tend to be lower percentage carbon producers, but this tendency will be somewhat offset by the trend toward heavier feed stocks. Carbon-burning limitations are constantly being reduced, for example, along the lines mentioned above, but the distribution of investment in a catalytic unit and the economics of catalytic processing are such that the removal of other limitations will probably be justified so as to utilize maximum carbon-burning capacity of the equipment. It may generally be expected that carbon burning will continue to be a major ultimate process limitation of catalytic cracking.

The limitations in the way of feed preheat, vaporization, and other preparation steps, as well as those in the fractionation and light ends part of the equipment are usually either minor in character or can be removed by a reasonable expenditure, since the equipment involved is separate from the reaction and coke-burning sections. Here again, the equipment built for wartime service may be more than adequate because of the increased severity for aviation-gasoline manufacture. On the other hand, some Houdry units built for treaters of first-pass base stock have had to be provided with flashing facilities to permit the running of heavy stocks. Murphree et al[19] point out for the Fluid units that with the raising of

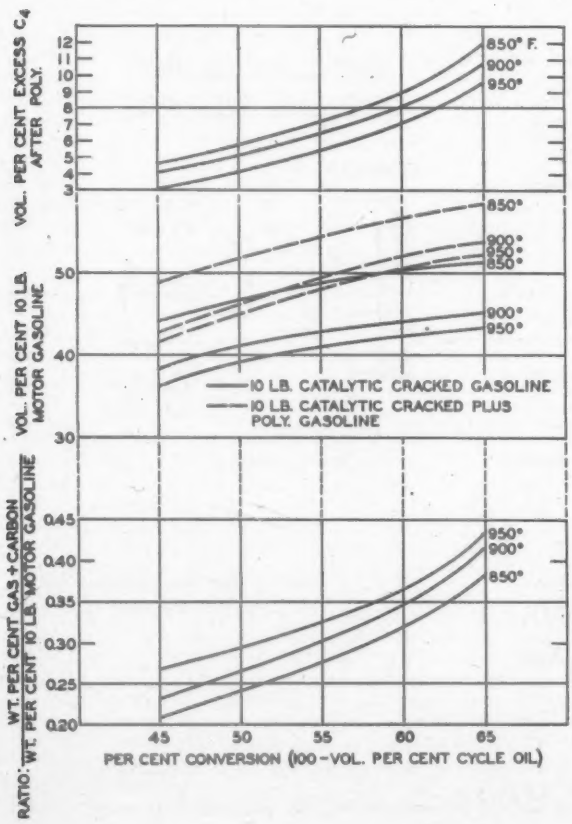
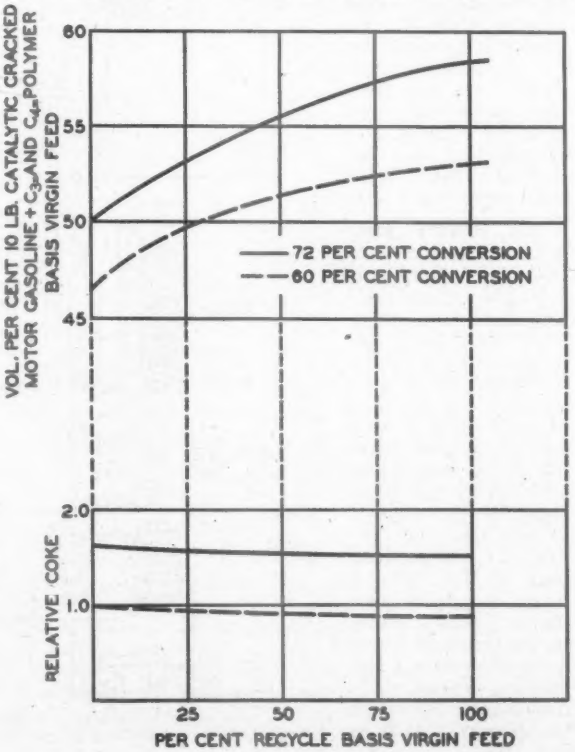

VOL. PER CENT EXCESS C_4 AFTER POLY.
850° F.
900°
950°
VOL. PER CENT 10 LB. MOTOR GASOLINE
850°
900°
950°
10 LB. CATALYTIC CRACKED GASOLINE
10 LB. CATALYTIC CRACKED PLUS POLY. GASOLINE
WT. PER CENT GAS + CARBON / WT. PER CENT 10 LB. MOTOR GASOLINE
RATIO:
PER CENT CONVERSION (100 - VOL. PER CENT CYCLE OIL)

Fig. 1-2—(Left) Trend of product distribution with temperature and conversion

Fig. 1-3—(Below) Trend of yields from recycle catalytic cracking


VOL. PER CENT 10 LB. CATALYTIC CRACKED MOTOR GASOLINE + C_3 AND C_4 POLYMER BASIS VIRGIN FEED
72 PER CENT CONVERSION
60 PER CENT CONVERSION
RELATIVE COKE
PER CENT RECYCLE BASIS VIRGIN FEED

pressure on the regenerator a corresponding rise in pressure on the fractionator is permitted under which conditions capacity is adequate for increased feed rates and only minor changes are necessary to permit utilizing full carbon-burning capacity.

Feed Stocks

A substantial portion of the existing catalytic-cracking equipment is constructed with alloy liners and other corrosion resistant parts in the reaction, fractionation and light-ends sections, to permit the running of the high-sulfur feed stocks above approximately 0.5 to 0.6 per cent sulfur and ranging up to 2.5-3.0 per cent. Where such feed stocks are available, the ability of the equipment to process them may control important economic advantages. Present trends indicate an expanded use of high-sulfur crudes, both from domestic and foreign sources. The remaining units of both the Thermofor and Fluid units can be equipped for sour stocks where conditions warrant, although with a substantial expenditure and shutdown time. One Houdry unit equipped with corrosion-resistant alloys has been in operation for several years.

The range of feed stocks usable for motor-gasoline manufacture in catalytic-cracking units is wide and has been rather extensively noted in the literature.[4,5,6,7,20] They range from materials of the naphtha or kerosene type through the gas oils to the residuals such as whole reduced crudes and deasphalted residuum. It is to be noted that both the Fluid and Thermofor processes are announced to be capable of handling heavy liquid feed direct to the reactor system.[4,7,9,20] The character of the feed stock and particularly its carbon yield is important with regard to the operating limitations discussed above. From the economic standpoint, the preferable feeds to catalytic cracking tend to be those of higher-boiling range because of the high over-all value of products compared to thermal cracking, especially where there is available market for distillate fuels.

Effect of Operating Conditions

In the setting of operating conditions on a given feed stock one of the primary considerations is the relation of carbon and fixed gas production to that of motor gasoline, over the range of operating conditions possible on the equipment. With increase in conversion (100-volume per cent cycle oil), motor-gasoline yield increases, but at the same time the production of carbon plus dry gas increase at a faster rate with consequent decrease in liquid product recovery. The same is true of increase in temperature. Fig. 1-2 shows a typical relationship of the yields for once-through catalytic cracking of a paraffinic gas oil. The lower three curves show the relation of total C_3 and lighter plus carbon to 10-lb. catalytic-cracked motor-gasoline yield over a range of conversions, of 850°, 900° and 950° F. It will be noted that the relative carbon plus gas increases with increasing conversion and that the higher-temperature operation produces the greater amount of them. This latter effect prevails despite the fact that carbon production in the high-temperature operation is lower, and is due to the lower gasoline and higher gas yields at higher temperature. In the center of Fig. 1-2 are shown the motor-gasoline curves, both catalytic cracked only, and catalytic cracked plus polymer gasoline, showing variation of yield with conversion. It will be noted that with increased conversion the total catalytic plus polymer gasoline tends to rise the more rapidly with conversion due to the availability of increasing amounts of C_3 and C_4 olefins. The excess C_4 saturates shown at the top of Fig. 1-2 increase more rapidly as conversion is raised. This last-mentioned effect tends to offset the higher carbon and gas with increase in conversion, particularly where there is a use or market for the excess butane. The lower conversion operations tend to be desirable from the standpoint of carbon limitations and consequent higher throughput when limited by carbon, and when feed stock is available, although it may in some cases be economic to run at the maximum attainable conversion when feed stock is limited. Quality of catalytic-cracked gasoline is affected by both temperature and conversion, increases in either improving both A.S.T.M. and research octanes.

Recycling

The desirability of recycling gas oil is related to the trends shown in Fig.

(Continued on page 81)

Fig. 1-4—Relative motor-gasoline production from virgin vs. recycle feed

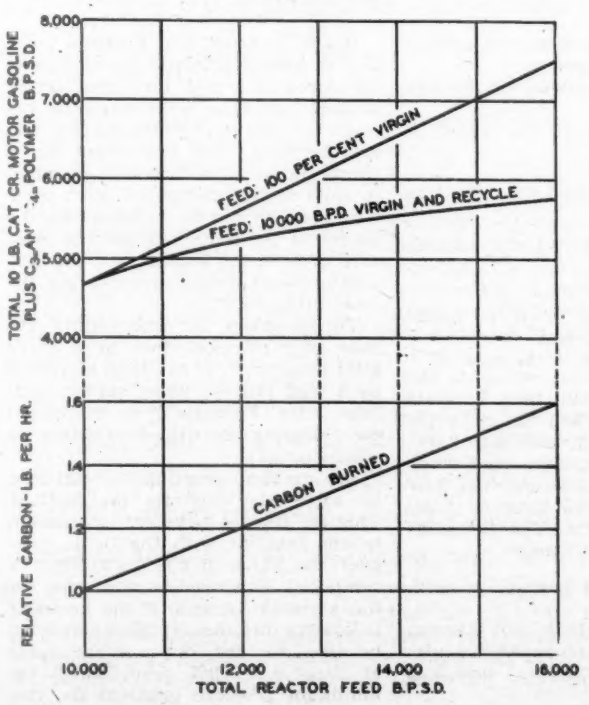
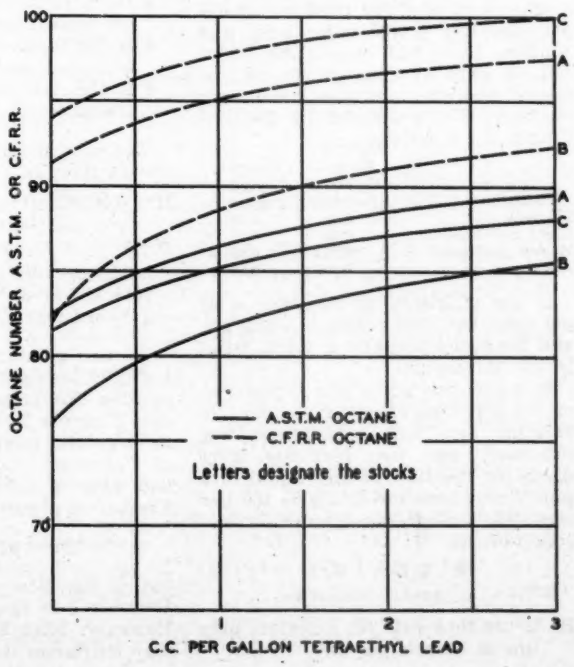


Fig. 1-5—Lead susceptibility of some typical catalytic cracked gasolines (400 e.p.) from low-sulfur feed stocks



Calculation of Throughput

—when several liquids flow simultaneously through a pipe line

by Benjamin Miller

PIPE lines of the oil industry transport liquids varying from propane to heavy crudes. It is customary to classify pipe lines on the basis of the commodities transported into crude lines and products lines. Crude lines may carry different oils from time to time, and products lines quite commonly are used to transport various products. The rate at which liquid will flow through a pipe line depends upon the difference between the inlet and outlet pressures and the gravity and viscosity of the liquid. While many discussions of pipe-line flow have been published, none which the author has seen gives a method for calculating the flow rate when several liquids having different properties are flowing simultaneously through a pipe line. This case occurs frequently, particularly in products lines, which may contain liquefied petroleum gas, several grades of gasoline, kerosene, and distillate fuel oil at one time.

As an illustration there may be considered a 20-in. line transporting simultaneously propane, light gasoline, heavy gasoline, and kerosene. The line has a nominal wall thickness of ¼ in. and is constructed with A.P.I. Grade C seamless pipe, suitable for a maximum working pressure of 650 psi. The line is 100 miles long, and contains 50,000 bbl. of propane, 50,000 bbl. of light gasoline, 50,000 bbl. of heavy gasoline, and the balance is kerosene. The properties of the four liquids are as follows:

Product—	Sp. gr., referred to water	Viscosity, centipoises
Propane	0.51	0.11
Light gasoline	0.68	0.31
Heavy gasoline	0.74	0.65
Kerosene	0.80	2.00

If the efficiency of the line is 95 per cent, the inlet pressure is 650 psi. and the outlet pressure is 0 psi., what is the throughput?

In a previous paper[1] the application of the pipe-line efficiency concept to gasoline pipe-line calculations was discussed, and two formulas were given for the flow of any liquid in a pipe line whose efficiency is 100 per cent. The first formula, valid for viscous flow, is

$$B^* = 23.8\ I\ d^4/z \qquad (1)$$

where:

B^* is the flow rate for a perfect pipe line in barrels per day,

The author of this article is making his second appearance in the technical section of the Journal. In this discussion, he presents calculations on the delivery through a pipe line containing more than one liquid. In the January 7, 1943, issue Miller presented a discussion on "Application of Pipe-Line Efficiency Concept to Gasoline Pipe Line Calculations." Since 1944, the author has been active in consulting work. Previously, he served the Institute of Gas Technology in Chicago in orienting the institute's educational program. After receiving a professional degree in chemical engineering from Columbia University in 1926, he became associated with Henry L. Doherty and Cities Service Co. For the next 16 years he worked on various technical and economical phases of oil and gas production, transportation, refining, and marketing, including engineering advice on some patent matters.

I is the pressure gradient in pounds per square inch per mile,
d is the inside diameter of the line in inches, and
z is the viscosity of the liquid in centipoises.

The second formula, valid for turbulent flow, is

$$B^* = 4.06(d^5 I/s)^{1/2}\ (\log d^5 s\ I/z^2 + 4.35) \qquad (2)$$

where:

s is the specific gravity of the liquid referred to water, and
log means logarithm to the base 10.

It was pointed out that Formula 1 should be used when the Reynolds number (Re) is not greater than 2,000, that Formula 2 should be used when Re is greater than 3,000, and that flow at Reynolds numbers between 2,000 and 3,000 is unstable. The Reynolds number in a perfect line is

$$Re = 92.25\ B^* s/dz \qquad (3)$$

but if the flow rate is not known, Formula 3 is not convenient to use. However, from Formulas 1 and 3 it may be shown that

$$I_{v,\,max} = 0.91\ z^2/sd^3 \qquad (4)$$

where:

$I_{v,\,max}$ is the maximum pressure gradient for viscous flow if the maximum Reynolds number for viscous flow is 2,000;

while from Formulas 2 and 3 it may be shown that

$$I_{t,\,min} = 3.20\ z^2/sd^3 \qquad (5)$$

where:

$I_{t,\,min}$ is the minimum pressure gradient for turbulent flow if the minimum Reynolds number for turbulent flow is 3,000.

Formulas 1-5 are sufficient to calculate the efficiency of a pipe line carrying a single liquid if the actual flow rate is known, because

$$e = B/B^* \qquad (6)$$

where:

e is the efficiency of the pipe line, and
B is the actual flow rate in barrels per day.

If the efficiency is known, the flow rate corresponding to a known pressure gradient can also be calculated. However, the formulas cannot be used conveniently for calculating the pressure drop required to cause a particular turbulent flow rate. For this purpose another formula was derived from the same experimental data on which Formula 2 is based; this formula is

$$B^* = 7.30(d^5 I/s)^{1/2}\ (\log B^* s/dz + 1.11) \qquad (7)$$

It will be noted that Formula 7 can also be used to compute the total pressure drop in a pipe line transporting several liquids at a known rate, because the line can be divided into several sections, each containing but a single liquid, the pressure gradient in each section computed, each pressure gradient can be multiplied by the length of the section to get the pressure drop in the section, and the several pressure drops added to get the total pressure drop.

The problem of determining the flow rate corresponding to a given total pressure drop can then be solved by a trial process, using various trial flow rates. Formula 2 is convenient for obtaining the trial flow rate with which to start.

The problem posed above will now be solved to illustrate the method. That the flow is turbulent is apparent to one familiar with the field; however, the value of z^2/sd^3 will first be computed. This need be done only for the kerosene because if the kerosene is flowing turbulently, the others must be also. For the kerosene the value of z^2/sd^3 is 0.00067, from which the minimum pressure gradient for tur-

bulent flow is 0.0022. The total pressure drop being 650 psi., and the length being 100 miles, the average pressure gradient is 6.5, so that the flow is turbulent.

While the average pressure gradient is 6.5, the flow rate is the same for all the liquids, so that the pressure gradient will be greater than 6.5 in the section containing kerosene and less than 6.5 in the section containing propane.

If the line were filled with kerosene, the flow rate would be less than it is with the composite filling. By inserting the specific gravity and viscosity of kerosene into Formula 2, with the pressure gradient taken as 6.5, there is obtained

$$B^* = 4.06(19.5^5 \times 6.5/0.80)^{1/3} [\log (19.5^5 \times 0.80 \times 6.5/2.00^3) + 4.35] \quad (2a)$$

from which B* is 162,000. It follows that the correct value of B* is greater than 162,000.

If the line were filled with propane, the flow rate would be greater than it is with the composite filling. By inserting the specific gravity and viscosity of propane into Formula 2, with the pressure gradient taken as 6.5, there is obtained

$$B^* = 4.06(19.5^5 \times 6.5/0.51)^{1/3} [\log (19.5^5 \times 0.51 \times 6.5/0.11^3) + 4.35] \quad (2b)$$

from which B* is 260,000. It follows that the correct value of B* is less than 260,000.

Having found two values between which B* must lie, an intermediate value may be used for trial in Formula 7. In order to narrow the range still further, computations may be made for the light gasoline and for the heavy gasoline. It is found that if the light gasoline alone were being transported, the value of B* would be 208,000, while if the heavy gasoline alone were being transported, the value of B* would be 187,000.

A volume of 50,000 bbl. occupies 25.64 miles in a pipe whose inside diameter is 19.5 in. The three sections of 50,000 bbl. each require 76.92 miles, leaving 23.08 miles as the length of the section filled with kerosene.

Four values have been obtained for B*, one for each liquid. Weighting each value by the length of the section occupied by the corresponding liquid, there is obtained 205,000 as the weighted average trial value of B*.

Inserting this trial value of B* into Formula 7 there is obtained one equation for each liquid, as follows:

$$205{,}000 = 7.30(19.5^5 I'_p/0.51)^{1/3} [\log (205{,}000 \times 0.51/19.5 \times 0.11) + 1.11] \quad (7a)$$

$$205{,}000 = 7.30(19.5^5 I'_l/0.68)^{1/3} [\log (205{,}000 \times 0.68/19.5 \times 0.31) + 1.11] \quad (7b)$$

$$205{,}000 = 7.30(19.5^5 I'_h/0.74)^{1/3} [\log (205{,}000 \times 0.74/19.5 \times 0.65) + 1.11] \quad (7c)$$

$$205{,}000 = 7.30(19.5^5 I'_k/0.80)^{1/3} [\log (205{,}000 \times 0.80/19.5 \times 2.00) + 1.11] \quad (7d)$$

where:

I'_p is the pressure gradient required in the section containing propane at the trial flow rate,

I'_l is the pressure gradient required in the section containing light gasoline at the trial flow rate,

I'_h is the pressure gradient required in the section containing heavy gasoline at the trial flow rate, and

I'_k is the pressure gradient required in the section containing kerosene at the trial flow rate.

From these equations it is found that I'_p is 4.240, I'_l is 6.357, I'_h is 7.684, and I'_k is 10.000. Multiplying each pressure gradient by the length of the corresponding section, and adding together the section pressure drops so computed, the total pressure drop is found to be 699.5 psi., which is 49.5 psi. higher than the maximum allowable working pressure. Therefore the trial value of B* was too high.

However, it is not necessary to repeat the process with another trial value of B*. Multiplying the value of the pressure gradient in each section at the trial flow rate by the ratio of 650 to 699.5 gives values for the pressure gradients in the several sections which will produce a total pressure drop of 650 psi. These pressure gradients are 3.940 for the section containing propane, 5.907 for the section containing light gasoline, 7.140 for the section containing heavy gasoline, and 9.292 for the section containing kerosene. Insertion of these values for I in Formula 2 gives four equations for B*, as follows:

$$B^* = 4.06(19.5^5 \times 3.940/0.51)^{1/3} [\log (19.5^3 \times 0.51 \times 3.940/0.11^3) + 4.35] \quad (2c)$$

$$B^* = 4.06(19.5^5 \times 5.907/0.68)^{1/3} [\log (19.5^3 \times 0.68 \times 5.907/0.31^3) + 4.35] \quad (2d)$$

$$B^* = 4.06(19.5^5 \times 7.140/0.74)^{1/3} [\log (19.5^3 \times 0.74 \times 7.140/0.65^3) + 4.35] \quad (2e)$$

$$B^* = 4.06(19.5^5 \times 9.292/0.80)^{1/3} [\log (19.5^3 \times 0.80 \times 9.292/2.00^3) + 4.35] \quad (2f)$$

The four equations yield four values of B*, which are 197,800; 197,700; 197,400; and 197,300 respectively. These are identical within the accuracy possible in pipe-line flow calculations, which proves that the pressure gradients in the four sections are correct.

The pressure drops in the four sections are 101, 151, 183, and 215 psi., respectively, making the total pressure drop 650 psi.

Since the efficiency of the pipe is 95 per cent, the actual throughput is 188,000 bbl. per day.

The method for calculating the throughput when several liquids flow simultaneously through a pipe line may be summarized as follows:

Step 1.—Calculate the value of $3.20 z^2/sd^3$ for the most viscous liquid to determine the minimum pressure gradient for turbulent flow. If the flow is not turbulent, the liquids will mix in the pipe line.

Step 2.—By means of Formula 2, calculate what the flow rate would be if the efficiency were 100 per cent and the line contained only the most viscous liquid.

Step 3.—Perform Step 2 for each of the other liquids.

Step 4.—Compute the weighted average of the flow rates obtained in Steps 2 and 3, weighting each flow rate by the fraction of the line occupied by the corresponding liquid; this weighted average flow rate is the trial flow rate.

Step 5.—By means of Formula 7 calculate the pressure gradient required in each section of the line to produce the trial flow rate at 100 per cent efficiency.

Step 6.—Multiply each pressure gradient found in Step 5 by the length of the corresponding section, and add the products to obtain the total pressure drop required for the trial flow rate at 100 per cent efficiency. In general this will not be equal to the specified pressure drop.

Step 7.—Calculate the ratio of the total pressure drop found in Step 6 to the specified pressure drop.

Step 8.—Multiply each pressure gradient found in Step 5 by the ratio found in Step 7 to get a pressure gradient for each section which will be consistent with the specified pressure drop.

Step 9.—By means of Formula 2 and using the pressure gradients found in Step 8, calculate the flow rate in each section at 100 per cent efficiency. These should be substantially identical, none differing from the average by more than 1 per cent.

Step 10.—Multiply the average flow rate found in Step 9 by the efficiency of the pipe line.

While the method as outlined applies only to a horizontal pipe line, the modifications necessary if there are changes in elevation should be obvious.

Literature Cited

1. Miller, The Oil and Gas Journal, Vol. 41, No. 35, January 7, 1943, p. 122.

Bearing CORROSION

by H. H. Zuidema

PART 3

This installment concludes the series which began in the issue of February 16. In it, the author, research worker with Shell Oil Co., Inc., discusses results of investigations of the company's Wood River laboratories. Complete bibliography for the entire series is published at the end of this installment.

Factors Influencing Corrosion

CORROSION, which is one of several possible causes of bearing failure, is in turn influenced by a number of factors. The effect of composition of the bearing, both chemical, as determined by analysis, and physical, such as grain structure and the presence of thin films of dissimilar metals, has already been discussed. Corrosion of a given bearing alloy is determined by the following factors:

1. Temperature.
2. Bearing load.
3. Venting.
4. Type of fuel.
5. Oxidation stability of lubricant.
6. Type of deterioration products formed in lubricant.
7. Detergency.
8. Passivation of bearing surface.
9. Action of sulfur.
10. Presence of water.

The first four and the last are "engine," and the remaining five "oil" factors. Certain of these factors are in a sense interrelated, but there is in all cases a clear-cut distinction.

1. Temperature.—The temperature at the bearing-oil interface is determined by the temperature of the bulk oil and of the adjacent metal parts and the rate of oil flow, which is in turn a function of the clearance between bearing and shaft. It is in general much higher than the bulk oil temperature.

Temperature affects corrosion principally through its effect upon rate of oxidation of the lubricating oil, which amounts to an approximate doubling per 10° C. rise in temperature, as expressed in the classical Arrhenius equation.

Raymond[35] studied the effect of temperature on bearing weight loss in a diesel engine operating with coarse-structure copper-lead bearings. His data are summarized in Table 6. It will be observed that corrosion was much more severe at the higher temperature, in spite of the shorter time. The average weight loss was 0.198 g. per 500 hours at the lower temperature, and 3.533 g. per 100 hours at the higher. If, for purposes of comparison, it is assumed that weight loss is a linear function of time, then the rate is 5 × 3.533/0.198, or 89, times as great at the higher temperature. Substitution in the Arrhenius equation shows that an 89-fold increase in rate per 30° F. corresponds to a doubling in rate per 4.5° F. (2.5° C.), increase in temperature, or a 16-fold increase per 10° C. increase. This temperature coefficient is far greater than that normally encountered in oxidation studies, indicating that additional temperature effects are present. These may include a mechanical factor. The hardness of bearing alloys decreases with temperature,[35] and any weight loss through abrasion would be expected to be more serious at the higher temperature. Furthermore, in the case of the oils containing additives, there is a possibility that decomposition of the additives occurred at the higher temperature.

TABLE 6—EFFECT OF TEMPERATURE ON BEARING WEIGHT LOSS IN DIESEL ENGINE USING Cu-Pb BEARINGS

Data from Raymond[35]
(All weight losses in grams per bearing shell)

	Connecting rod*		Main†	
Length of run	500 hours	100 hours	500 hours	100 hours
Bulk oil temperature	230° F.	260° F.	230° F.	260° F.
Oil A, commercial, nonadditive	0.091	0.270	0.066	1.031
Oil A + Additive I (inhibitor, detergent)	0.505	0.837	0.203	0.594
Oil B, nonadditive	0.355	5.755	0.244	4.861
Oil B + Additive III (inhibitor)	0.216	1.650	0.192	3.610
Oil C, commercial additive	0.050	8.596	0.055	8.129

*Weight losses for upper shell only. †Weight losses for lower shell only.

2. Bearing load.—This factor is in general not critical. Variation in thrust from 15 to 125 psi. has comparatively little effect upon corrosion in the T.B.C. apparatus. The small effect noticed was attributed to effect upon rate of shear, or removal of the products of corrosion.

3. Venting.—Degree of venting can affect corrosion in two ways, and the two operate in opposite directions. With increased air flow, oxidation rate is increased, thus increasing the rate of formation of corrosive acids; however, the more volatile acids are removed by venting, so that the net effect may be one of increased or decreased corrosion, depending upon the relative importance of the two factors. The effect of crankcase ventilation upon bearing weight loss in C.F.R. engine equipped with copper-lead bearings has been studied at Wood River. An increase in weight loss with increased ventilation was observed, indicating that in this case the effect of increased rate of oxidation predominated. Davis,[11] on the other hand, found a marked decrease in the weight loss of cadmium-silver bearings with increased venting, both in the Underwood test and in a Pontiac engine. The difference in trend in the two cases is quite striking. Several factors may be responsible for this difference. The engines used were different, although this does not appear to be an important factor here, since Davis found the same trend in the Underwood test and in the Pontiac engine. The most important point of difference, however, appears to be the type of bearing used; cadmium-silver in the one case, and copper-lead in the other.

These results can be explained by the hypothesis that cadmium-silver is more readily corroded than copper-lead by the more volatile acids, while the reverse is true in the case of the heavier, nonvolatile oxidation products. If this is true, venting should be maintained at a maximum with cadmium-silver bearings. The effect of venting on copper-lead is of a smaller magnitude and may be in the opposite direction.

4. Type of fuel.—Variation in fuels in internal-combustion engines can have a pronounced influence upon bearing corrosion. The following factors may be involved with gasolines of varying composition: (1) Acids produced by oxidation of the fuel may be corrosive; (2) the lacquer-depositing tendency of unstable fuels affects bearing corrosion, probably both directly, through the deposition of lacquer on the bearing surface, and indirectly, through passivation of the metal surfaces in the engine as a whole, thus reducing metal catalysis; (3) the decomposition products of tetraethyl lead fluid in the fuel lead to the formation of iron halides, which constitute the active portion of "crankcase catalyst";[38] thus deteriora-

tion of the lubricant is more rapid when a leaded fuel is used; (4) lead soaps formed from tetraethyl lead may act as detergents, thus making the metal surfaces more vulnerable to attack and resulting in increased catalysis by engine metals.

5. Oxidation stability of lubricant.—Fresh oils are in general only slightly, if at all, corrosive. They become corrosive primarily through oxidation, although decomposition products of additives, and deterioration products of the fuel may act as corrosive agents. The stability of an oil is determined by a number of factors, particularly temperature, the availability of oxygen, and the presence of impurities or additives which may act as antioxidants, anticatalysts, or catalysts.

6. Type of deterioration products formed in lubricant.—While oxidation stability is an important factor in bearing corrosion, it does not necessarily follow that oils of equal stability are equally corrosive, for the exidation products may differ greatly in their effect on bearing metals. Products such as ketones, aldehydes, and esters probably have no effect, whereas acids and peroxides do. Even the acids themselves vary widely in their corrosive properties.

7. Detergency.—Excessive sludging and lacquering in an engine is highly objectionable, and has been overcome by the incorporation of peptizing agents which are more commonly known as detergents. The use of detergents aggravates corrosion problems in that the surface of the bearings is left bare and vulnerable to attack by acids. The importance of lacquer films in protecting against corrosion is indicated in Table 7, which summarizes a portion of some work done by Downing et al[12] on catalysis by engine metals. Tests 1 and 3 were identical except that in Test 1 the bearings were prelacquered in a four-hour runin, while the remainder of the engine was initially clean, whereas in Test 3 the bearings were clean and the other engine parts prelacquered. The large difference in weight loss shows the effectiveness of lacquer in protecting a bearing surface against corrosion. If the other engine parts had been comparable in the two tests, the difference should have been even greater.

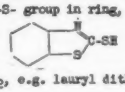
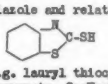
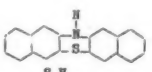
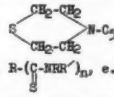
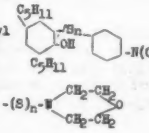
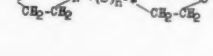
TABLE 7—EFFECT OF LACQUER FILM ON BEARING CORROSION

35 hours in Chevrolet engine
Crankcase temp. 275° F. Jacket temp. 230° F.
Data from Downing, Holbrook and Fuller[12]

Test No.	Weight loss of copper-lead bearing, mg./sq. in./ 1,000 miles
1. Undoped oil, lacquered bearings, clean engine	3.98
3. Undoped oil, clean bearings, lacquered engine	34.38

8. Passivation of bearing surface.—Control of bearing corrosion in the presence of detergents is difficult to

APPENDIX 1 (CONTINUED)—SUMMARY OF COMPOUNDS CLAIMED IN U. S. PATENTS AS BEARING CORROSION INHIBITORS

Pat No. & date issued	Inventor	Compound	Concentration (per cent)
		5. Compounds Containing Both Sulfur and Nitrogen	
2,154,097 4/11/39	Loane, C. M.	Compounds containing N=C-S- group in ring, e.g. mercapto benzothiazole 	0.2
2,160,880 6/6/39	Loane, C. M., and Shoemaker, B. H.	Thiocarbamates, S=C-NR$_1$R$_2$, e.g. lauryl dithio carbamate; tin diamyl dithio carbamate. Also thiuram monosulfides, S=C-NRR' S-C S , e.g. tetra methyl thiuram monosulfide	0.2
2,162,207 6/13/39	Moran, R. C., and James, W. H.	Dianiline disulfide, $(C_6H_5NH_2)$-S-S-$(C_6H_5NH_2)$	0.05-0.25
2,168,666 8/8/39	Cannon, M. R.	Reaction product of sulfonated oil and urea	2.0
2,190,648 2/20/40	Cantrell, T. L., and Turner, J. O.	Reaction product of S and diaryl amine, e.g. phenthiazine,	0.2
2,209,484 7/30/40	Loane, C. M., and Shoemaker, B. H.	Thiourea derivatives, S=C-NRR', e.g. dibutyl thiourea, diphenyl thiourea	0.05-0.2
2,218,283 10/15/40	Fuller, E. W.	Mercaptobenzothiazole and related compounds 	0.25
2,218,918 10/22/40	Loane, C. M., and Shoemaker, B. H.	Thiocyanates, e.g. lauryl thiocyanate, $C_{12}H_{25}SCN$; lauryl isothiocyanate, $C_{12}H_{25}NCS$	0.2
2,220,723 11/5/40	Lewis, A. W.,	Sulfurized nitrogen compounds, e.g. sulfurized diphenylamine, di-beta-naphthylamine, etc.	0.2
2,220,970 11/12/40	Loane, C. M., and Shoemaker, B. H.	Pseudothioureas, R-S-C=N-H, where R is hydrocarbon radical or condensation product of thiourea and mustard oil, e.g. CH_2=CH-CH_2-N=C=S / HS-C=N-C_6H_5 HN-C_6H_5 mustard oil thiocarbanilide	0.2
2,224,158 12/10/40	Marks, E. M., and Johnson, J. W.	Aryl substituted thioureas, e.g. phenyl, o-tolyl S=C-NRR'	0.05-0.5
2,227,908 1/7/41	Lewis, A. W.	Thio di-beta-naphthylamine 	0.2
2,230,691 2/4/41	Lewis, A. W.	Thio amides and thio anilides, R-C-N-R$_1$, e.g. thio benzanilide, thio propionamide	0.2
2,236,168 3/25/41	Dietrich, M. A.	Sulfonamides, R-S-NRR', e.g. NN'(di-p-toluene sulfonyl) piperazine, NN' (di-p-toluene sulfonyl) 1,2 ethane diamine	0.5
2,252,793 8/19/41	Watkins, F. M.	Thioamides, R-C-NRR', e.g. thio benzanilide, C_6H_5-C-N-C_6H_5; N lauryl thio benzamide, C_6H_5-C-N-$C_{12}H_{25}$	0.5
2,257,752 10/7/41	Lincoln, B. H., and Byrkit, G. D.	Quaternary ammonium salt of sulfur-bearing acid, e.g. triamyl ammonium mercapto stearate; cyclohexyl ammonium salt of sulfurized soy bean oil acids	0.001-0.1
2,269,265 1/6/42	Hamilton, L. A., Fuller, E. W., and Berger, H. G.	Reaction product of sulfur chloride / tertiary amine, e.g. sulfur chloride / dibutyl phenylamine -- mixture of mono-, di-, and higher sulfides NH-R$_3$-S$_n$-R$_3$-N-R	0.1
2,269,282 1/6/42	Moran, R. C., Badertscher, D. E., and Berger, H. G.	N Substituted morpholines, e.g. N-amyl morpholine, 	0.25
2,280,578 4/21/42	Manford, E. W., and Salzberg, P. L.	Thio amides, R-(C-NRR')$_n$, e.g. N N di-n-octyl dithioadipamide, C_8H_{17}-N-$(CH_2)_4$-N-C_8H_{17}	
2,281,521 4/28/42	Fuller, E. W.	Reaction product of formaldehyde, and amine, and a mercaptan, e.g. ethyl- or diamyl aniline; amyl mercaptan, R-S-CH_2-R-NR'R''	0.25
2,290,316 7/21/42	Cook, E. W.	Sulfurized aldehyde amines, R-CH-N-R, e.g. thioheptaldehyde n-amyl amine	
2,310,670 2/19/43	Badertscher, D. E., Crandall, C. S., and Seger, F. M.	Thiocyanates, RR'R''-SCN, e.g. triphenyl methyl thiocyanate; alpha naphthyl diphenyl methyl thiocyanate	0.25
2,321,578 6/15/43	Clayton, J. O., and Farrington, B. B.	Nitrogen-containing esters, e.g. R-C-O-CH_2-C-R'R''	0.1-1.0
2,322,184 6/15/43	White, E. R.	Thio semicarbazones, RR'C=N-N-C-NH_2	1.0
2,345,239 3/28/44	Cook, E. W., and Moss, P. H.	Amino disulfides, e.g. 2 hydroxy 3,5 di tert. amyl 4' diethylamino disulfide 	0.5-0.75
2,351,657 6/20/44	Bayes, A. L.	Dimorpholine-polysulfides, 	0.5 1.0

achieve by the use of antioxidants alone, since the bearing surface is attacked in the presence of very low concentrations of acids in some cases. It is generally preferable to add a compound which is capable of laying down a protective film on the bearing surface. In the case of copper-lead bearings sulfur compounds seem to act in this manner. The mechanism is probably that of the formation of a complex containing both copper and sulfur. These films are readily discernible by their dark color.

This does not mean that sulfur compounds act solely through this mechanism. Many undoubtedly act as antioxidants and deactivators for soluble catalysts as well, but passivation is in general their principal function. Examples of this type of additive are presented in the appendix.

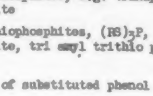
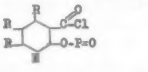
9. Action of sulfur.—As indicated earlier, copper can be attacked preferentially in a copper-lead bearing by the action of sulfur at high temperatures. This highly undesirable condition, in which hard brittle particles of black material (probably copper sulfide) are broken off, probably differs from the formation of the desirable passivating films only in degree. As long as the film remains thin and adheres to the bearing surface it protects against acid corrosion, but when it becomes thick and begins to flake off, due probably to change in composition as well as thickness, it constitutes corrosion, though not of the acid type.

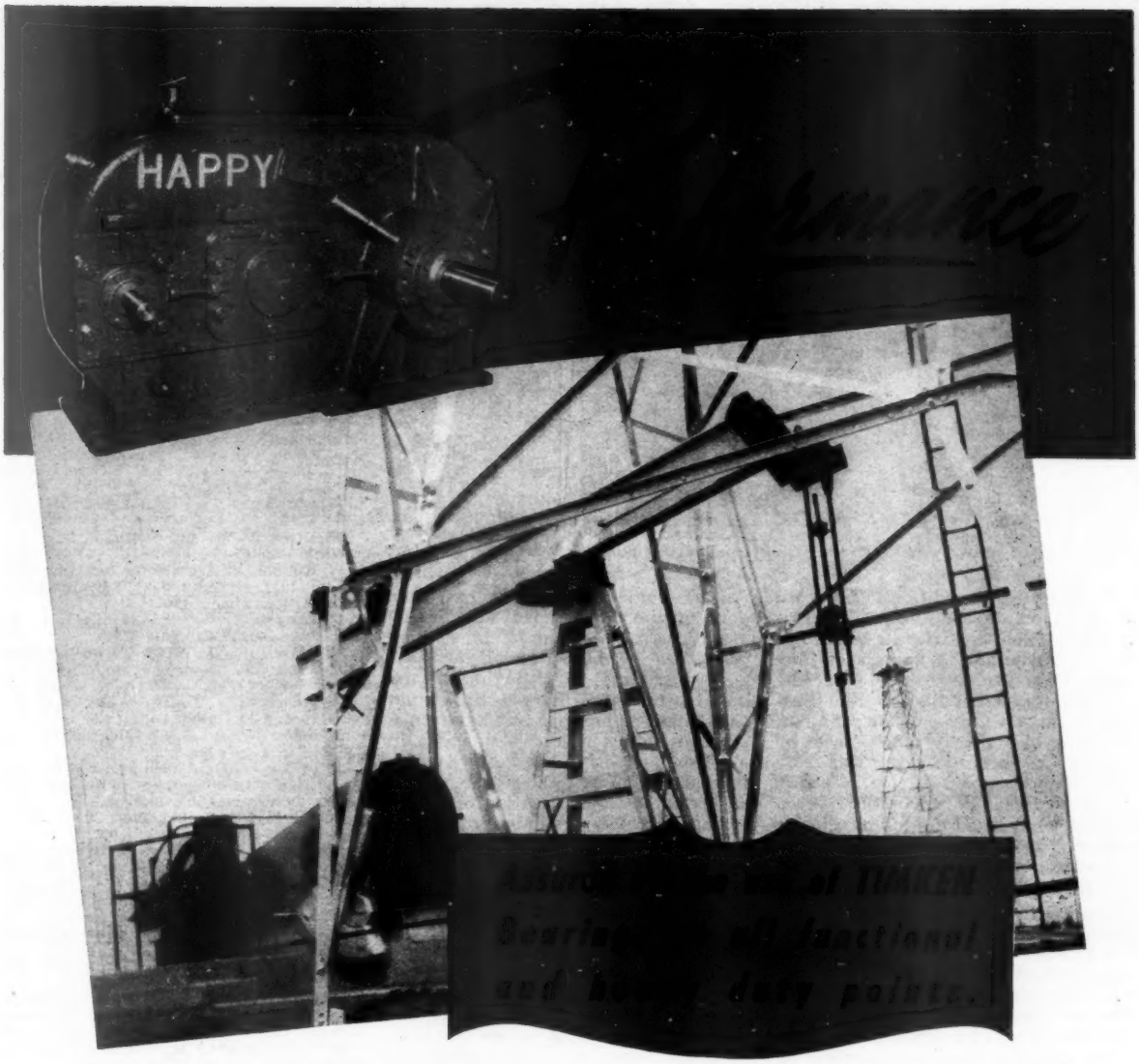
10. Presence of water.—Water probably affects corrosion in several ways. Under anhydrous conditions acids tend to dehydrate to anhydrides, while in the presence of water they revert to the acid form, which is probably much more corrosive. The presence of a separate water phase is, of course, necessary for the third type of corrosion mentioned earlier, namely corrosion by aqueous acids. In addition, the presence of water has a pronounced effect upon rate of oxidation of an oil because of its effect on the rate of solution of catalytically active metals.[24]

Lead-base babbitt is readily corroded in oxidation tests conducted in the presence of water. This was clearly demonstrated in a recent cooperative A.S.T.M. program in which turbine oil stability tests, in which the oil is oxidized in the presence of water, copper, and iron at 95° F., were run on two oils in the presence of tin base and lead base babbitt.* The former bearing metal showed no appreciable weight loss, even when the oil was allowed to deteriorate somewhat beyond the end of its induction period, whereas the latter lost as much as several hundred milligrams per test specimen, which had an area of approximately 15 sq. cm.,

*The babbitt used in this work contained about 1 per cent tin. There have been recent indications that lead-base babbitt containing 5 per cent of tin is much more resistant to this type of corrosion.

APPENDIX 1 (CONTINUED)—SUMMARY OF COMPOUNDS CLAIMED IN U. S. PATENTS AS BEARING CORROSION INHIBITORS

Pat No. & date issued	Inventor	Compound	Concentration (per cent)
		6. Compounds Containing Both Sulfur and Phosphorus	
2,169,634 8/15/39	Cantrell, T. L., and Turner, J. O.	Reaction product of phosphorus sesquisulfide, P_4S_3, / phenols, e.g. butyl phenol, 2,4 ditert. butyl phenol	1.0
2,174,019 9/26/39	Sullivan, F. W.	Thio esters of phosphinous acid and of phosphinic and thiophosphinic acid, where a / b = 3 $R_aP(SR_1)_b$; $R_aP(=S)(SR_1)_b$,	
2,178,610 11/7/39	Salzberg, P. L.	Naphthenyl thio phosphites, e.g. trinaphthenyl trithio phosphite	0.5
2,191,996 2/27/40	Shoemaker, B. H., and Loane, C. M.	Alkyl and aryl thiophosphites, $(RS)_3P$, e.g. triphenyl trithio phosphite, tri amyl trithio phosphite	0.2
2,226,336 12/24/40	Cantrell, T. L., and Turner, J. O.	Reaction product of substituted phenol / P_2S_5	1.0
2,252,985 8/19/41	Rutherford, J. T., and Miller, R. J.	Calcium salt of phosphoric acid ester which contains sulfur, e.g. Calcium cetyl phenyl thio-phosphate $S=P(-O-C_6H_5)(-O-C_{16}H_{33})(-O-Ca/2)$	1.0
2,253,228 8/19/41	Cantrell, T. L., and Turner, J. O.	Reaction product of substituted phenol / sulfur Chloride / FCl_3	0.5-1.0
2,259,452 10/21/41	Berger, H. G., James, W. H., and Badertscher D. E.	Reaction product of aromatic o-phosphite carboxylic acid chloride,  and mercaptan	0.1-0.25
2,260,303 10/28/41	Engelke, E. F.	Chlorophosphine sulfides, e.g. di-p-methyl phenoxy chlorophosphine sulfide, $(CH_3\text{-}C_6H_4\text{-}O)_2\text{-}P(=S)\text{-}Cl$	1.0-1.5
2,274,025 2/24/42	Yule, J. S.	Sulfurized and phosphorized fatty acids and oils, e.g. lard oil	1.0-5.0
2,316,078 4/6/43	Loane, C. M., and Gaynor, J. W.	Reaction product of polyisobutylene / P_2S_5	2.0
2,316,087 4/6/43	Gaynor, J. W., and Loane, C. M.	Product obtained by reacting the product from the reaction sulfurized oil / P_2S_5 with alkali, e.g. KOH	1.0
2,316,091 4/6/43	White, C. H.	Salt, e.g. Ca, Ba, K, of reaction product resin-like petroleum fraction / P_2S_3 of P_2S_5	1.0
2,321,307 6/8/43	Mikeska, L. A., and Lieber, E.	Trialkyl trithiophosphites, e.g. triamy trithiophosphite, $(C_5H_{11}\text{-}S)_3P$	0.1
2,321,576 6/15/43	Clayton, J. O., and Farrington, B. B.	Thioesters containing trivalent P, e.g. $R\text{-}CH(-O-C(=S)-R')\text{-}P(-S)$	0.5-2.0
2,350,959 6/6/44	Cook, E. W., and Thomas, W. D.	Reaction product of oil soluble petroleum sulfonate, e.g. Ba petroleum sulfonate, / P_2S_5	0.5
		7. Compounds Containing Both Nitrogen and Phosphorus	
2,157,479 5/9/39	Cantrell, T. L., and Peters, J. G.	Ammonia or oil-soluble amine salt of reaction product of phenol / PCl_3, e.g. diphenyl amine salt of reaction product of PCl_3 and substituted phenol made from phenol and C_4 olefin	0.25-1.0
2,223,941 12/3/40	Musher, S.	Phosphite ester / 25% its quantity of lecithin, $CH_2\text{-}O\text{-}CO\text{-}R$; $CH\text{-}O\text{-}CO\text{-}R$; $CH_2\text{-}O\text{-}P(=O)(OH)\text{-}O\text{-}CH_2\text{-}CH_2\text{-}N(CH_3)_3$	0.8 total
2,257,601 9/30/41	Towne, C. C., and Hall, F. C.	Lecithin of other phosphatide	0.1
2,259,452 10/21/41	Berger, H. G., James, W. H., and Badertscher, D. E.	Reaction product of aromatic o-phosphite carboxylic acid chloride, / amine 	0.1-0.25
2,279,218 4/7/42	Badertscher, D. E., Williams, R. H., and Bergex, H. G.	Reaction product of amine, e.g. mono methyl aniline or N amyl aniline, and product of reaction of aromatic hydroxy carboxylic acid, e.g. salicylic acid, / PCl_3	0.1-0.25
		8. Miscellaneous	
2,160,881 6/6/39	Loane, C. M., and Shoemaker, B. H.	Organic esters of selenous acid, $O=Se(XR)_2$, $O=Se(Y)\text{-}XR$, where X is S or O, and Y is a halogen, e.g. dibutyl selenite, $(C_4H_9)_2\text{-}Se(=O)\text{-}O$	0.25
2,160,917 6/6/39	Shoemaker, B. H., and Loane, C. M.	Boric acid esters, BXR_3, and X-BXR, where X is O or S, e.g. tributyl borate	0.25
2,177,561 10/24/39	Cook, E. W.,	Triphenyl stibine, $(C_6H_5)_3\text{-}Sb$	0.2
2,187,802 1/23/40	Colin, P. G., and Lewis, A. W.	Tin tetrabutyl, $(C_4H_9)_4\text{-}Sn$	0.2
2,211,558 8/13/40	Colin, P. G., and Lewis, A. W.	Tin tetraphenyl, $(C_6H_5)_4\text{-}Sn$	0.05-0.15
2,213,856 9/3/40	Cook, E.W.	Alkyl arsenites, $(RO)_3As$, e.g. triisoamyl arsenite	0.2
2,214,444 9/10/40	Vartaressian, K. A.	Arsenites, $(RO)_3As$, e.g. triphenyl, or tricresyl arsenite	0.5
2,250,188 7/22/41	Wilson, C. E.	Reaction product of CaO / condensation product of alkyl phenol / formaldehyde	0.5-1.0
2,258,591 10/14/41	Moser, F. H., and Dijkman, A. J.	Zinc diisopropyl salicylate	0.5-1.5
2,262,326 11/11/41	Fairlie, M., and Beare, L. E.	$Ca(OH)_2$, applied in oil filter to neutralize corrosive acids	
2,262,327 11/11/41	Fairlie, M., and Beare, L. E.	BaO or SrO, applied in oil filter to neutralize corrosive acids	
2,262,328 11/11/41	Fairlie, M., and Beare, L. E.	Same, with BaO / CaO, CaO / SrO, or BaO / SrO	
2,266,325 12/16/41	Izsar, A., and Buedrich, P. M.	Calcium sulfonate	1.0



Smooth, steady and dependable performance has characterized the year in and year out service experienced by operators of Happy Pumpers. Built into the design of these ruggedly built units are shafts, gears and bearings of known quality — parts that require minimum attention for lubrication and maintenance. Timken Bearings were selected to give permanent protection against friction; wear; radical thrust, and misalignment. May we furnish you with further facts about Happy Pumper Performance?

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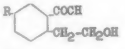
APPENDIX 1 (CONTINUED)—SUMMARY OF COMPOUNDS CLAIMED IN U. S. PATENTS AS BEARING CORROSION INHIBITORS

Pat No. & date issued	Inventor	Compound	Concentration (per cent)
2,281,401 4/28/42	C. E. Wilson	Salts of strong bases and very weak acids which act as buffers by reacting with strong acids formed by oxidation and liberated weak acid, e.g. Li, Na, K, Ca, or Ba salt of phenols, thiophenols, oximes, etc.	1.0
2,305,627 12/22/42	Lincoln, B. H., and Byrkit, C. D.	Metal derivatives of enols, particularly tin compounds containing Cl, e.g. stannic acetylacetone dichloride, $Sn(CH_3\text{-}CO\text{-}CH\text{=}C(O\text{-})\text{-}CH_3)_2Cl_2$	0.1-1.0
2,308,502 1/19/43	Farrington, B. B. Clayton, J. O., and Etzler, D. H.	Metal alkyl carboxylates containing hydroxyl groups, e.g. K cetyl tartrate, Mg cetyl citrate	0.25-0.5
2,312,207 2/23/43	Clayton, J. O., and Farrington, B. B.	Derivatives of ortho arsenous acid, $R\text{-}As\text{-}(OH)_2$; and of arsonic acid, $R\text{-}AsO\text{-}(OH)_2$, e.g. calcium cetyl arsonate, $C_{16}H_{33}\text{-}As(=O)(O\text{-})\text{-}O\text{-}Ca$	0.5
2,312,208 2/23/43	Clayton, J. O., and Farrington, B. B.	Esters and salts of boronic acid, $R\text{-}B(OH)_2$, and borinic acid, R_2BOH, e.g. calcium cetyl boronate, $C_{16}H_{33}\text{-}B(=O)(O\text{-})\text{-}O\text{-}Ca$	0.35-0.5
2,320,241 5/25/43	Jenkins, V. N.	Alkaline earth soaps of hydroxy acids capable of forming lactones, e.g. 	0.5-1.0
2,321,576 6/15/43	Clayton, J. O., and Farrington, B. B.	Esters containing trivalent As or Sb, e.g. $R\text{-}CH(As)\text{-}CO\text{-}OR$, $R\text{-}C(Sb)\text{-}O\text{-}CH_2\text{-}CH\text{-}R$	0.5-2.0

under identical conditions. The ease of corrosion of lead-base babbitt is in marked contrast with its resistance to the conventional acid type of corrosion as shown in Table 1, and the difference is attributed to the presence of water. Corrosion of cadmium alloys is also greatly influenced by presence of moisture.

Control of Corrosion

Miller[21] has listed the following four principal means of controlling bearing corrosion:

1. Use of new bearing types, such as sandwich type, and indium treated bearings.
2. Operation of engines at lower temperatures.
3. Selection and refining of crude used in the manufacture of the oil.
4. Use of suitable inhibitors.

The use of proper venting might be added to this list. Of these five, only the third and fourth are directly controlled by the oil manufacturer.

In the selection and treatment of crude, the proper choice will depend upon whether or not additives are to be used. If a mineral oil is to be used straight it should be selected and refined for maximum stability under conditions comparable to those to which it will be subjected in actual use, whereas an oil to be used as base stock for a compounded product should be chosen and refined for maximum susceptibility to the additives used.

While considerable control over bearing corrosion can be exercised by the proper choice of stocks and treating method, the extent to which such control is possible is limited. Engines which require the hard alloys as bearing metal are often operated under conditions which are severe for the oil as well as for the bearings. The trend is, therefore, toward the incorporation of additives rather than relying solely upon the base stock.

A large amount of work has been done on the development and testing of anticorrosive agents for lubricating oils. Miller, Winning, and Kunc[22] listed 105 patents on antioxidants and metal passivators in 1940. Since that time many more patents have been granted in this field, as indicated in a recent paper by Wright,[42] which lists 662 United States patents on antioxidants for lubricating oils.

Appendix 1 is a summary of compounds for which inhibition of bearing corrosion is specifically claimed in United States patents. One hundred sixty-three patents are covered. It should be understood that this compilation is not intended as a complete patent survey, but to illustrate the various types of compounds that have been patented as corrosion inhibitors. Some of these act as antioxidants, some as catalyst deactivators, others as metal passivators, and some would probably not show any beneficial effects in actual service, the patent claims being based upon laboratory results obtained under conditions quite foreign to engine operation. The compounds covered in Appendix 1 are classified into eight groups according to their composition. It will be observed that most of them contain one or more of the following three elements: sulfur, nitrogen, and phosphorus. It is difficult to generalize on the mechanism of the action of members of the various groups, since experiments reported were run in the presence of catalysts. However in view of what is known about various types of additives, it is probable that most of the phenols and compounds containing nitrogen or phosphorus act principally an antioxidants, whereas most of the sulfur compounds serve primarily as metal passivators and as deactivators.

Bibliography

1. Anthony, J. K., S.A.E. Journal, 49, 339 (1941).
2. Automotive Industries, Oct. 23, 1937, p. 562.
3. Babbitt, I., U. S. Patent 1,252 (1839).
4. Blackwood, A. J., and Cloud, G. H., S.A.E. Journal, 51, 408-14 (1943).
5. Brasch, W., Tech. Zentr. prakt. Metallbearbeit, 46, 452-8 (1936).
6. Bregman, A., Iron Age, pp. 65-67, Aug. 13, 1942; pp. 42-45, Aug. 20, 1942.
7. Clawson and Bals, Inc., Engine Bearing Manual, Chicago, 1944.
8. Corse, W. M., Bearing Metals and Bearings, Chemical Catalog Co., New York, 1930.
9. Denison, G. H., Ind. Eng. Chem., 36, 477-82 (1944).
10. Darby, E. R., U. S. Patent 2,246,462; C. A., 35, 5,851 (1941).
11. Davis, L. L., Paper presented at A.S.T.M. Committee D-2 meeting, June 1938, at Atlantic City.
12. Downing, F. B., Holbrook, G. E., and Fuller, J. H., A.C.S. Petroleum Division Preprints Baltimore meeting, Apr. 1939.
13. Evans, E. A., World Petroleum Congress, London, 1933, Proc., 2, 460-1.
14. Geniesse, J. C., Paper presented at A.S.T.M. Committee D-2 meeting, June 1942, at Atlantic City.
15. Gersdorfer, O., Metallwirtschaft, 21, 563-4 (1942).
16. Hives, E. W., and Smith, F. L., S.A.E. Journal, 46, 106-17 (1940).
17. Kuhnel, R., Werkstoffe fur Gleitlager, Berlin, 1939, reproduced by Edwards Bros., Ann Arbor, Mich., 1943.
18. Larsen, R. G., and Armfield, F. A., Ind. Eng. Chem., 35, 581-8 (1943).
19. Larsen, R. G., A.C.S. Petroleum Division Preprints, New York meeting, Sept. 1944.
20. Melhuish, M. J., Inst. Automotive Engineers, 9, 1-12 (1940).
21. Miller, F. L., S.A.E. Journal, 45, 290 (1939).
22. Miller, F. L., Winning, W. C., and Kunc, J. F., A.C.S. Petroleum Division Preprints, Detroit meeting, 1940.
23. Mougey, H. C., Ind. Eng. Chem., News Ed., 14, 425-8 (1936).
24. Prutton, C. F., Frey, D. R., Turnbull, D., and Diouhy, G., Ind. Eng. Chem., 37, 90-100 (1945).
25. Raymond, L., S.A.E. Journal, 50, 533-7 (1942).
26. Ryan, J. G., U. S. Patents 2,116,851; 2,136,655 (1938).
27. Smart, C. F., Trans. A.I.M.E., 128, 295-307 (1938).
28. Talley, S. K., Larsen, R. G., and Webb, W. A., A.C.S. Petroleum Division Preprints, Atlantic City meeting, Sept. 1941, pp. 173-86.
29. Tichvinsky, L. M., S.A.E. Journal, 51, 69-77 (1943).
30. Underwood, A. F., A.S.T.M. Symposium on Lubricants 1937, 29-52.
31. Underwood, A. F., S.A.E. Journal, 43, 385-92 (1938).
32. Underwood, A. F., S.A.E. Journal, 46, 99 (1940).
33. von Fuchs, G. H., Petroleum Z., 29, No. 11, P 5-8 (1933).
34. von Fuchs, G. H., Wilson, N. B., and Edlund, K. R., Ind. Eng. Chem., 13, 306-12 (1941).
35. von Fuchs, G. H., and Zuidema, H. H., U. S. Patent 2,276,526, Mar. 17, 1942.
36. Waters, G. W., and Burnham, H. D., Ind. Eng. Chem., 36, 263-71 (1944).
37. Waters, G. W., and Larson, E. C., Ind. Eng. Chem., Anal. Ed., 15, 550-9 (1943).
38. Watson, R. A., S.A.E. Journal, 48, 41-50 (1941).
39. Willi, A. B., S.A.E. Journal, 45, 513-25 (1939).
40. Willi, A. B., S.A.E. Journal, 50, 62-72 (1942).
41. Wolf, H. R., S.A.E. Journal, 48, 128-37 (1941).
42. Wright, W. A., National Petroleum News, 37, No. 1, Sec. 2, R34-7 (1945).

Acknowledgment

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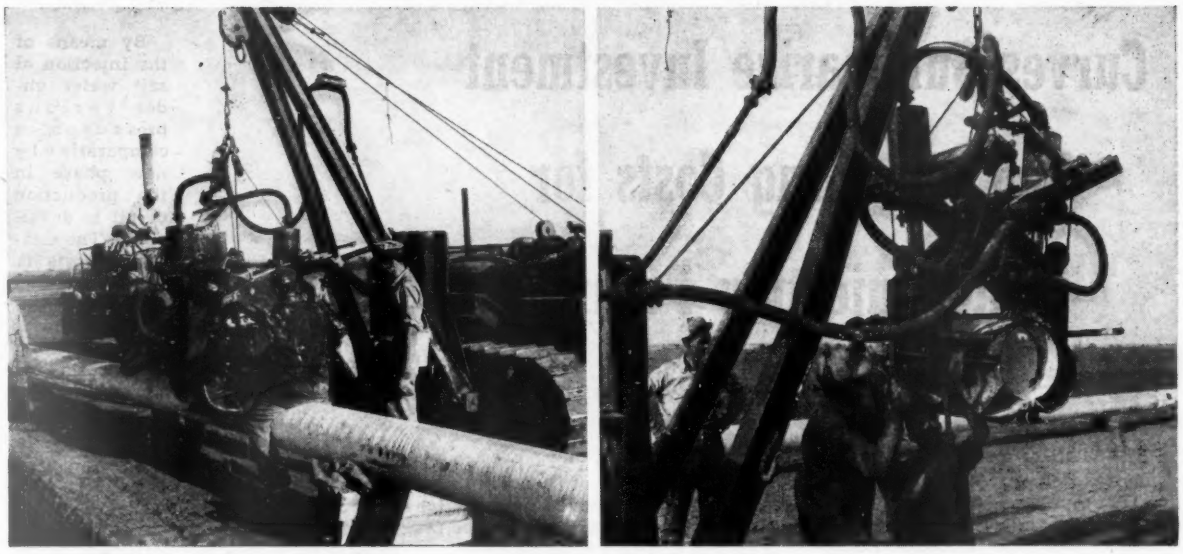


Left: Placing hydraulic clamp for application of coating over bare space on pipe adjacent to field weld. Right: Hydraulic coating-clamp being prepared for operation on the line

Special Equipment Expedites Pipe-Line Coating

by Paul Reed

THE recent Chickasha project of Oklahoma Natural Gas Co. is unusual for the Oklahoma area because of the extent to which Somastic coating has been applied on the pipe of the 26 miles of 12¾-in. o.d. laid; more than 20 miles has been coated with this material. The line is for high-pressure service receiving gas at well pressures of approximately 1,000 lb. and delivering at 500 lb. The pipe is of telescope design with three wall thicknesses: 5/16-in., 9/32-in. and .259-in. With the exception of 8,800 ft. of 9/32-in. electric welded pipe all of the pipe for the project is seamless. Pipe-laying operations were contracted by H. C. Price Co.

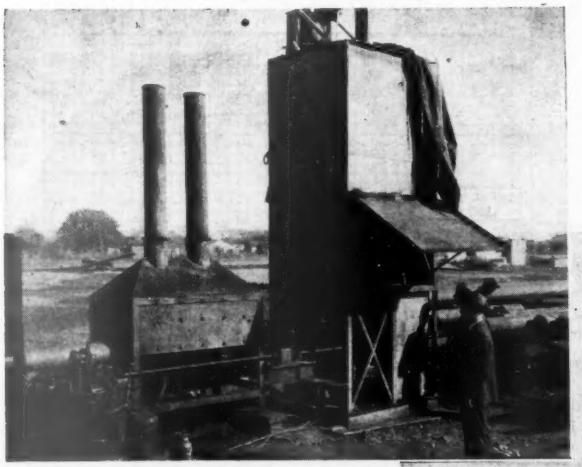
Coating has been applied with standard plant equipment of Industrial Engineering Co., installed at a temporary yard at Chickasha. Prior to the application of coating the pipe is cleaned by sand blasting.

The most distinctive feature of operations along the right-of-way has been the use of the recently developed hydraulic clamp for applying coating on the bare space at the ends of each joint. This bare space is left in the yard coating operation so as to facilitate welding of joints in the field along the ditch.

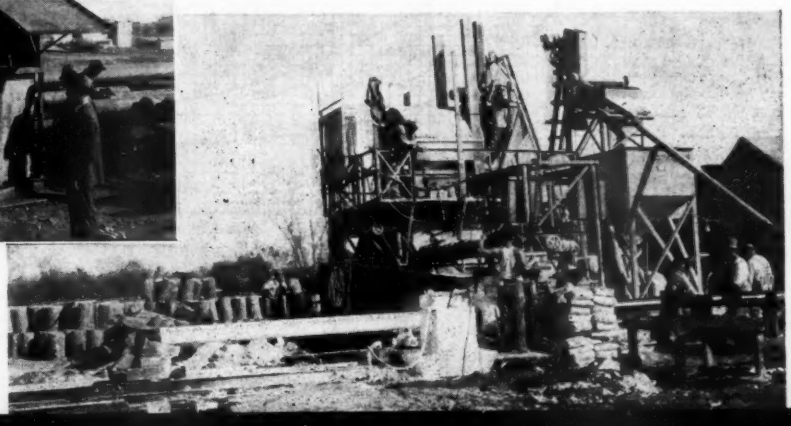
By use of the clamp it is possible to coat over the pipe near the welds at the rate of 100 to 150 joints per day. By this procedure the use of a large crew of men applying coating at the bare ends of joints by means of numerous manually operated clamps can be eliminated.

The hydraulic clamp is carried by a boom tractor on which pump equipment is installed for forcing Somastic coating material through hose connections for application in the clamp under hydraulic pressure. The operation is accomplished by: (a) lowering the clamp over the pipe; (b) securing the equipment in place; (c) opening valves to force coating against the pipe; and (d) releasing the clamp almost immediately ready to move to the next position.

The increased efficiency resulting from this equipment contributes to the effectiveness of the entire pipe-line-construction operation.



Below: Mill for applying coating at temporary yard



Above: Sand-blasting operations for cleaning pipe before coating in the mill

Curves Summarize Investment And Operating Costs for Water-Injection Plants

by Lloyd T. Gibbs

By means of the injection of salt water under various pressures, a comparatively new phase in the production of oil is developing. The matter of costs is important, and considerable time may be consumed in obtaining these figures for different situations. Below is briefed an easy method of obtaining quickly the approximate costs for various rates and pressures. The author is head of Lloyd T. Gibbs Co., Tulsa.

OPERATION of an hydraulic power plant closely approaches the operation of pipe-line stations, electric power plants, and other similar constant-load, full-time operating installations. Therefore, consistent average operating costs can be obtained with considerable accuracy if the necessary investment items are assembled and the proper operating costs factors are appropriately treated.

The chart in Fig. 1 shows the power-plant costs in cents per barrel to inject salt water into the producing formation at various quantities and pressures. Five curves are shown on this chart, each curve representing a particular size of hydraulic power plant.

Investment costs of basic units in the power plants covered here are for a Sterling gas engine, a Falk gear reducer, and an Aldrich vertical-plunger pump equipped with porcelain plungers. All of this equipment has been in continuous full-load operation in pipe-line or salt-water service a sufficient number of years to arrive at average costs. Engine cooling is obtained by means of heat exchangers; and in each case the equipment is installed in a building.

Table 1 shows the investment in each plant, and the operating cost per day:

TABLE 1—PLANT DATA AS TO SIZES, INVESTMENT, AND OPERATING COSTS

Pumps and engines used—	No. of operators	Total plant investment	Operating cost per day
1—6-in. Triplex, 70 hp.	1	$12,630	$13.00
1—8-in. Triplex, 170 hp.	1	22,730	19.80
1—6-in. Quintuplex, 300 hp.	1	35,484	35.00
2—6-in. Quintuplex, 300 hp. each	2	70,968	64.00
4—6-in. Quintuplex, 300 hp. each	4	141,936	106.00

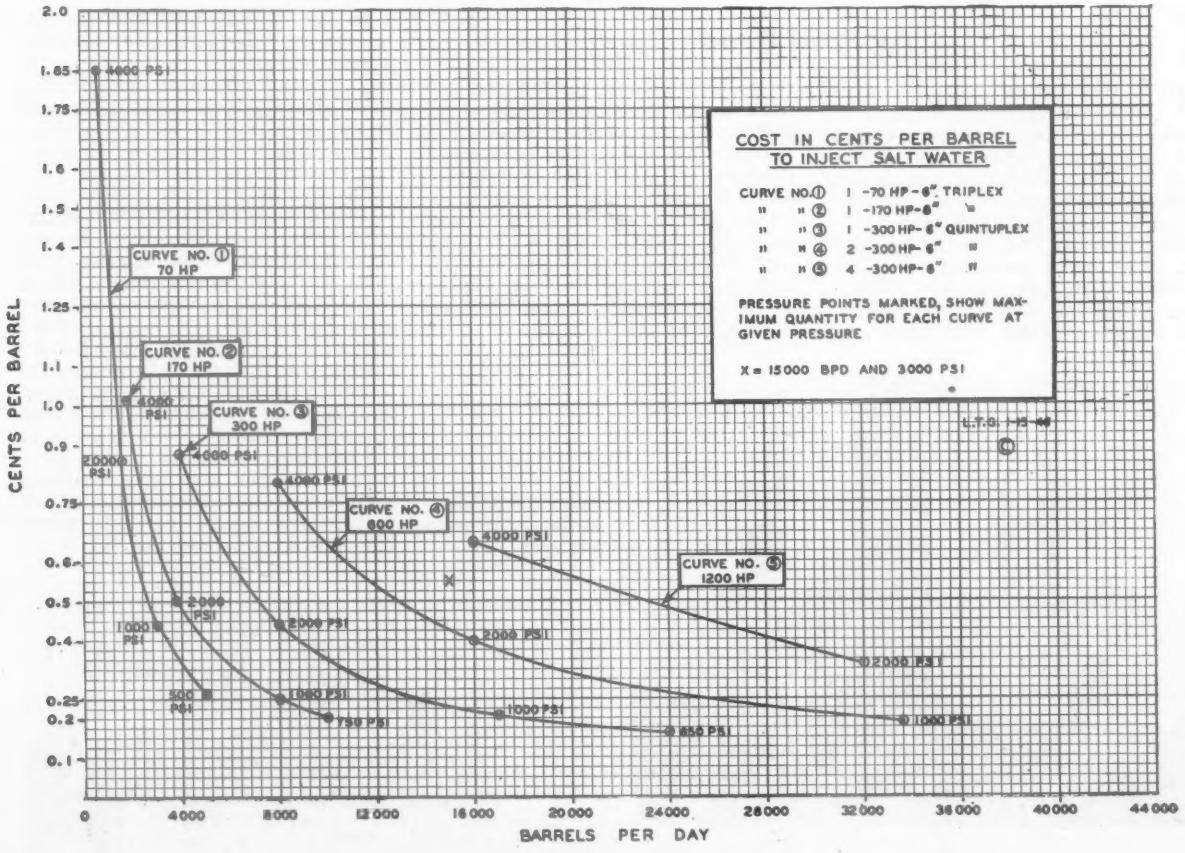


Fig. 1

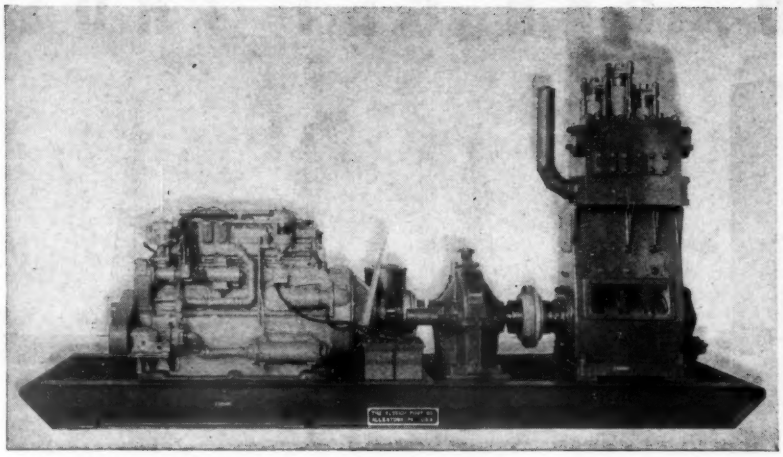


Fig. 2—Considerable operating performance has accrued to this power-gear-pump assembly used in high-pressure water-injection service in the Midway pool of Arkansas. Much interest in this producing method of primary pressure maintenance is evident in other oil-producing areas

Makeup of Operating Costs

The operating costs are based on the costs of operating the hydraulic power plant where water is furnished to the pump, and this water is delivered outside the building at the pressure desired.

The basic operating costs are made up of:

1. Gas at 4 cents per M cubic feet;
2. Labor at $200 per month per man;
3. Maintenance at $3 per installed horsepower per year; plus extra mechanic's labor for infrequent complete overhaul jobs;
4. Lubricating oil;
5. Extra miscellaneous items.

The total cost per day shown in the above table and on the curves of Fig. 1 also include capital charges based on 10 per cent per year. This is made up of 8 per cent for depreciation and 2 per cent for insurance and taxes.

Most plant installations may be different to certain degrees. In order to estimate quickly costs per barrel in a preliminary manner, the following divisions of the cost per barrel figures may be applied to other installations on a percentage basis:

Capital costs represent 32 per cent in the case of the first four plants, and 40 per cent for the last plant.

Labor represents 50 per cent for the first plant, 35 per cent for the second plant, and 30 per cent for the remaining three plants.

Fuel represents 13 per cent for the first four plants, and 16 per cent for the last plant.

These divisions thus show how each item affects the various curves, and the different percentages can be used as approximations to adjust the costs for any individual case. To illustrate:

Problem.—What will be plant operating cost of injecting salt water on the basis of 15,000 bbl. per day at 3,000 psi.?

Solution. — This particular cost is marked **"X"** in Fig. 1 and is found as follows:

3,000 psi. is halfway between the 2,000 and 4,000 points on Curves 4 and 5.

The slope of any new curve will be approximately parallel to the charted curves.

The stipulated conditions are, therefore, located at a cost position of 5.5 mills per barrel.

Another illustration. — On the assumption that the investment in filters, gathering lines, discharge lines, meters, etc., is equal to the plant investment:

The plant investment is halfway between Nos. 4 and 5 plants and, therefore, is approximately $110,000.

The capital costs represent 35 per cent of the 5.5 mills—or 1.9 mills.

Assume two more men added to the operating payroll (payroll doubled), 30 per cent equals 1.65 mills.

Assume also that the cost of gas will be doubled, or will cost 8 cents per M cubic feet. Fuel is approximately 16 per cent, which equals 0.88 mills.

These new additions, therefore, equal 4.43 mills. This is added to the basic figure of 5.5 mills, which totals approximately 1 cent per barrel.

The horsepower necessary is also approximated halfway between the fourth and last plants, or curves, which is 900 hp. The actual calculated horsepower is 860. The curves are, therefore, close enough for general preliminary studies.

The above illustrates the method of using the chart, and it is believed that within a few minutes anyone—by following the chart set-up and the percentages listed herein—can arrive at the approximate cost of injecting salt water.

Studies Possible for Other Prime Movers

For purchased electric power, the investment will decrease by approximately 30 per cent. Purchased power at 8 mills per kwh, giving proper credit to less mechanical repair labor, lubricating oil, gas, etc., will double all of the computed operating costs that are shown on the curves. If diesel engines are used, the operating costs are increased approximately 50 per cent due to the effect of the low cost of gas used in the above treatment; the investment cost is approximately 20 to 30 per cent more.

One other observation is made possible from Fig. 1, i.e.,

If one curve is drawn through each 4,000-psi. point, another through each 2,000-psi. point, etc., it will be shown that the cost of injection falls off very rapidly and the knee of these curves is 4,000 bbl. per day.

This means that in considering any project having injection pressures above 2,000 psi. and rates above 4,000 bbl. per day, the costs will be reasonably close to the lower limits, or moderate slope on the cost curves. Putting it another way, larger plants and higher capacities result in significantly lower unit costs.

BOOKS

CANOL. Text and documentary photographs by Richard Finnie. Produced for Bechtel-Price-Callahan by Ryder & Ingram, publishers. San Francisco. 210 pp.

This handsome volume describes the sub-Arctic pipe-line and refinery project constructed by Bechtel-Price-Callahan for the Corps of Engineers, U. S. Army, and is dedicated to the officers and men of the Army and the civilians "who went north together as pioneers and worked steadfastly toward the successful completion of construction of the Canol Project." It is a large book, 11 by 14 in., and is chiefly pictorial, many of the illustrations being full color.

Several pages of text are devoted to a general review of the project, the country, the contract, and the supplementary work, which, together with the vast number of halftone illustrations, effectively highlight the problems, the difficulties, and the achievements shared by all who built the project. Where the text leaves off, the pictures take up the account, and afford the reader a complete and absorbing vista of the project. These show building of the prefabricated housing for the base camp, the prefabricated barges and the unloading and transportation, the building of airfields, hauling materials, construction of wharfs, tank farms, bridges, and the multitudinous other phases of construction that must perforce precede the major job of installing the pipe line. Local color abounds—the Eskimo-soldier guards, the Indian guides, pack dogs, wild animal life. Feeding facilities for the workers, their recreation, and personal hardships also are portrayed. One chapter is devoted to the Whitehorse refinery.

The final chapter is titled "Mission Accomplished," and brings the story up to February 16, 1944, when the tie-in of the pipe line was performed. The golden weld was made just 20 months and 4 days after the first reconnaissance flight across the Mackenzie-Yukon divide.

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Catalytic Cracking

(Continued from page 63)

1-2 as well as to other factors such as the amount of feed stock which is available, and the limitations of the catalytic-cracking unit. This matter has been touched upon by Thomas et al[9] who point out that recycling is a means for increasing yield, whereas the highest production is possible through single-pass operations. Fig. 1-3 has been prepared to show the general relations prevailing between two recycling operations at different conversion and carbon production levels on a paraffinic gas oil.

Referring to the 10-lb. motor-gasoline yield curves in Fig. 1-3 it will be seen that a substantial increase in percentage yield on the basis of virgin feed, results from increased recycling and it is also shown by the other yield lines that carbon yield on the basis of virgin feed is approximately constant or decreases a small amount over the range of increasing recycle ratio covered. In comparing the motor-gasoline yield curves for the two conversion levels shown it will be seen that at the lower conversion and carbon level, approximately 30 per cent recycling will increase the percentage yield (and production from constant virgin feed) an amount equal to about 66 per cent increase in carbon production by once-through cracking alone. The higher carbon level would be possible without reducing fresh feed rates only if the unit had excess carbon-burning capacity and from the standpoint of increased daily production it would be better to produce the additional amount of carbon by increased fresh feed if it were available. This implies generally that if a unit is limited by available virgin feed and also by carbon-burning capacity, additional percentage yield basis virgin feed, and daily production, can be obtained by recycling. If, however, virgin feed is unlimited and the unit is burning maximum carbon it is generally economic to adjust the conversion to present the optimum balance between virgin feed and conversion with no recycling. It should be borne in mind that "conversion" in these recycling operations is expressed as 100 per cent minus the net cycle-oil production from the unit, hence for one of the constant conversion lines the per cent net gas oil yield basis virgin feed is constant over the whole range of recycle ratios and there is no change in the total amount of material for heating oil and/or thermal cracking. The illustration in Fig. 1-3 applies to a rather high range of conversion, and will naturally be different at lower conversion levels, although in the same direction.

Fig. 1-4 illustrates the general operating possibilities of a hypothetical unit not limited by carbon burning above an assumed feed rate of 10,000 bbl. per day, to show the relative production of 10-lb. motor gasoline by (1) straight increase in once-through feed, contrasted with (2) the production possible by recycling above 10,000 bbl. per day and making the same amount of carbon in either case at the same reactor throughput. Thus a once-through operation on 100 per cent virgin feed at 12,000 bbl. per day would produce 5,600 bbl. per day of 10-lb. motor gasoline at a relative carbon production per hour of 1.2, while 10,000 bbl. per day of virgin feed plus 2,000 bbl. per day of recycle with the severity adjusted to also make the same pounds per hour carbon would produce only 5,200 bbl. per day of motor gasoline. This shows again the preferability of virgin feed from the standpoint of daily production.

It should be understood that these figures represent typical examples and indicate certain general trends, and each feed stock and catalytic-cracking unit represents a different situation and requires a separate analysis from its own basic data.

Characteristics of Gasoline

The characteristics of catalytically cracked motor gasoline are somewhat similar, varying generally between 77 and 84 A.S.T.M. and between 85 and 96 C.F.R.-R., clear. Lead susceptibility reflects the unsaturated character of the product, as does the high C.F.R.-R. octane. There is a noticeable effect of cracking temperature on unsaturation which, in turn, results in the higher C.F.R.-R. values shown for the higher temperature operations. High-sulfur content of feed stock also has a depressing effect on octane and TEL susceptibility of catalytic-cracked gasoline from such stocks. No significant correlation of motor-gasoline properties with feed stock, operating conditions, and other variables, with the exception of the very general trends shown by Murphree et al[10] and some shown by Holaday and Happel[11] have appeared in the literature. Fig. 1-5 illustrates typical lead susceptibilities of a variety of catalytic-cracked gasolines. These properties, as well as volatility, are of great importance in the application of catalytic cracking to any individual refining situation, and while no inclusive correlations have been developed, the available data on this matter are to be covered in another article.

A feature of the catalytic-cracking processes when operating for motor gasoline is the production of a butane-butylene cut which may be in excess of that required for blending to 10 lb. R.v.p. The unsaturation of such excess B-B varies, from about 20 per cent to about 60 per cent, depending upon the charging stock, operating conditions, and catalyst. High temperatures favor unsaturation whereas high conversion favors saturation of the C_4 cut. It is possible, where refinery butane balances and processing permits, to polymerize the butylenes, as well as the recoverable part of the propylenes, and substantially augment the 10-lb. motor-gasoline yield. In addition, the saturated C_4 may be employed for alkylation. Following is an example of the cracked gasoline, polymer, and excess butane yields for the single-pass (zero recycle) operations illustrated in Fig. 1-3:

Catalyst	Synthetic	
Conversion, per cent	60	72
Yield, Vol. per cent:		
Cat. cracked 10-lb. motor gasoline	37.0	40.0
Butylene polymer, 10 lb.*	5.2	5.4
Propylene polymer, 10 lb.*	4.0	3.4
Total motor gasoline	46.7	48.8
Excess B-B	5.2	9.3

*Assumes 65 per cent recovery of C_3=, and 90 per cent recovery of C_4=.

The national significance of the excess B-B from catalytic cracking has been discussed by Barnard and Forrester.[3]

Catalyst

The comparative merits of synthetic and natural catalyst has been the subject of much study since the termination of all-out aviation-gasoline manufacture. One of the chief competitive factors is the large difference in cost, which is below $100 per ton for natural catalyst, dry basis, delivered, and from $300 to $600 per ton for the synthetic silica alumina catalysts. Some of the characteristics of a silica magnesia catalyst have recently been announced by Anderson and Sterba[12] with indication that it would be available at the same price as silica alumina. To offset the difference in price, however, natural catalyst is generally conceded to make substantially more carbon under comparable conditions than silica alumina,[13] and while comprehensive data seem lacking, the carbon production from natural is indicated to be in the range of at least 1.1 times that from silica alumina. In addition, there are data to indicate that in all processes, the makeup rates required for activity maintenance or because of attrition, will be substantially higher with natural. On the advantageous side, for natural, it is generally indicated to make about 1.0 to 2.0 per cent more 10-lb. motor gasoline than silica alumina under comparable conditions, with approximately that same amount of excess C_4 less than the latter. Another feature of difference is a substantially better gasoline octane, both motor and research, from synthetic catalyst. When all of these features are weighed in an over-all refining analysis, it is generally indicated that the low cost advantage of natural is a superficial one and that synthetic silica alumina is justifiable in many cases. Synthetic catalyst is being continued in use extensively in both Thermofor and Fluid units.

Catalytic cracking is a new and relatively expensive process and for

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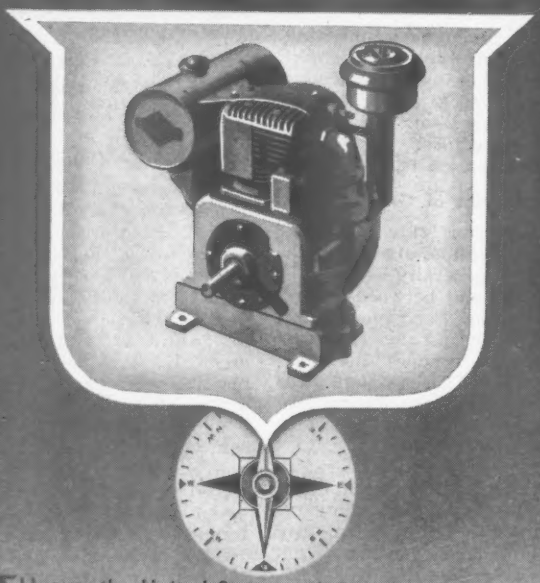

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that reason is still faced with much competition from older types of processing. Because of this, also, much care will be necessary in coordinating its operations with others, in order that it may show a justifiable return. With a continuation of the development work which has been responsible for the processes, its importance among refinery processes should increase.

References

1. R. H. Newton, G. S. Dunham and T. P. Simpson, "The T.C.C. Catalytic-Cracking Process for Motor Gasoline Production," The Oil and Gas Journal, June 2, 1945, p. 84.

2. Moore and Elder presented before Petroleum Section, A.I.M.M.E., New York, Feb. 1944.

3. D. P. Barnard and J. H. Forrester, "How Will the New Processes Affect the Postwar Light-Ends Situation," Petroleum Refiner, May 1944, p. 89.

4. G. H. Mateer and J. D. Haney, "Three Fluid Catalytic-Cracking Units Form the Heart of New Refinery," The Oil and Gas Journal, July 8, 1944, p. 87.

5. T. P. Simpson, L. P. Evans, C. V. Hornberg and J. W. Payne, "Recent Development in T.C.C. Processing," Proceedings of twenty-fourth annual meeting of A.P.I., Nov. 8, 1943, Section 3, p. 83.

6. T. P. Simpson, L. P. Evans, C. V. Hornberg, and J. W. Payne, "The Thermofor Catalytic-Cracking Process," Proceedings of twenty-third annual meeting of A.P.I., Nov. 9, 1942. Section 3, p. 59.

7. The Kelloggram, issued by the M. W. Kellogg Co., 225 Broadway, New York, 1945 series, Special Edition "Fluid Catalytic Cracking . . . "The 'Why' of Its Success."

8. C. L. Thomas, N. K. Andersen, H. A. Becker and J. McAfee, "Cracking With Catalysts," Proceedings of twenty-fourth annual meeting of A.P.I., Nov. 8, 1943, Section 3, p. 83.

9. T. P. Simpson, "T.C.C. Announces Liquid Processing, Using Pelleted Clay or Beaded Catalyst," The Oil and Gas Journal, May 12, 1945, p. 88.

10. E. V. Murphree, C. L. Brown, H. G. M. Fischer, E. J. Gohr, and W. J. Sweeney. "Fluid Catalyst Cracking for Premium Fuels." Proceedings of twenty-fourth annual meeting of A.P.I., Nov. 8, 1943. Section 3, p. 91.

11. W. M. Holaday and John Happel, "A Refiners' Viewpoint on Motor-Fuel Quality," S.A.E. Journal, Jan. 1943.

12. W. A. Schulze and C. J. Helmars, "Gas-Oil Cracking by the Cycloversion Process," The Oil and Gas Journal, Apr. 13, 1944, p. 225.

13. E. Houdry, W. R. Burt, A. E. Pew, Jr., and W. A. Peters, Jr., "The Houdry Process," The Oil and Gas Journal, Nov. 24, 1938, p. 40.

14. T. B. Prickett and R. H. Newton. "Recent Developments in Houdry Fixed-Bed Catalytic Processes," Proceedings of twenty-fourth annual meeting of A.P.I., Nov. 8, 1943, Section 3, p. 89.

15. E. V. Murphree, C. L. Brown, H. G. M. Fischer, E. J. Gohr and W. J. Sweeney, "Fluid Catalyst Process," Ind. & Eng. Chemistry, July 1943, p. 768.

16. The M. W. Kellogg Co., "A Study of Costs—The Economics of Postwar Motor Gasoline Refining," issued Dec. 1945.

17. H. D. Noll and V. O. Bowles. "Small Scale Catalytic Cracking," National Petroleum News, Oct. 3, 1945, p. R-767.

18. N. K. Anderson and M. J. Sterba, "Simplified Catalytic-Cracking Unit," The Oil and Gas Journal, Dec. 22, 1945.

19. E. V. Murphree, E. J. Gohr, H. Z. Martin, H. J. Ogorzaly, C. W. Tyson, "High Capacity Operations on Fluid Cracking Units," Petroleum Refiner, Nov. 1945, p. 423.

20. T. P. Simpson, S. C. Eastwood and H. G. Shimp, "Liquid Charge Technique in T.C.C. Processing," The Oil and Gas Journal, Nov. 24, 1945, p. 119.

QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

DESULFURIZATION—
Chemical versus Catalytic

In reading your Questions on Technology of November 17 and December 22 on chemical and catalytic desulfurization, I feel that a clear differentiation between straightrun and cracked gasolines is necessary in the study of these processes. Catalytic desulfurization is most often used for the treatment of straightrun, and chemical desulfurization for the treatment of cracked gasolines. You do not make this clear.—F.C.M.

In clarification of our items of November 17 and December 22, 1945, it should be stated that catalytic desulfurization is used almost totally on straightrun gasolines whereas chemical desulfurization may be used for fresh cracked gasolines or for straightrun gasolines. The general unsuitability of catalytic desulfurization for cracked materials was mentioned in our Question of October 13, 1945, page 137 and elsewhere, because of the short life of the catalyst.

In selecting a desulfurization process for a particular gasoline, it is necessary to test the gasoline in the laboratory for the effectiveness of the process. This is particularly necessary because of the enthusiasm of each of the vendors of processes for their own process. To some extent this enthusiasm may have colored the data published in the articles which were quoted in our Questions on Technology of October 6, October 13, November 17, and December 22, as well as The Refiner's Notebooks Nos. 63, 65, and 67 of October 13, October 27, and November 10, 1945; mainly because gasolines which do not react well to the processes being studied attract little attention or may never be completely examined by laboratory tests.

The suggestion or question of F.C.M. above so well stated the situation that it is being quoted here:

"There are sound theoretical and practical reasons why the choice of a desulfurization process generally follows this trend (catalytic for straightrun and chemical for cracked gasolines). The octane improvement obtained by the catalytic desulfurization of cracked gasolines is very similar to that obtained by chemical processes. The reason for this is that **fresh** cracked gasolines usually contain mercaptans and relatively thermally stable ring-sulfur compounds such as thiophenes. The ring-sulfur compounds are not decomposed appreciably by catalytic desulfurization, while the mercaptans can be removed by either catalytic desulfurization or by chemical processes. The sulfur compounds in straightrun gasolines, on the contrary, are in most cases predominantly unstable, such as mercaptans, sulfides and disulfides. All of these sulfur compounds can be readily broken down to hydrogen sulfide in the catalytic processes; whereas, only the mercaptan can be removed by the chemical processes. Therefore, the percentage removal of sulfur, by the catalytic process, from straightrun is greater than from cracked gasoline, and the resultant increase in lead susceptibility is correspondingly greater. For these reasons, it is not fair to compare catalytic desulfurization data of straightrun with chemical desulfurization of cracked gasoline.

"In the treatment of cracked gasolines, the chemical processes have many advantages over catalytic desulfurization. The effective life of clay or bauxite catalyst on cracked gasolines is only about 50 bbl. per ton, and, therefore, it is necessary to provide facilities for regenerating the catalyst. The process is very expensive to operate on cracked gasolines because of the regeneration requirements, necessity of rerunning, and polymerization loss of the gasoline being treated. The chemical processes, on the contrary, function very well on cracked stocks with only minute gasoline losses and offer, in some cases, other advantages, such as control of phenol content, uniformity of product and others.

"Since both types of process remove approximately the same amount of sulfur from cracked gasolines, octane improvements agree quite closely. You will sometimes find that catalytic desulfurization tests do show more improvement on cracked gasoline than do the chemical processes. Upon further investigation, however, this additional increase usually comes about because it is necessary to rerun the cracked gasoline following catalytic desulfurization which slightly lowers the end point.

"One factor, which contributes largely to the octane improvement of straightrun gasoline in the catalytic desulfurization process, is the isomerization which takes place. Numerous data are available showing octane improvements which cannot be accounted for on the basis of sulfur removal. The isomerization in cracked gasoline is largely negated by polymerization."

It is also pointed out that the cost of the chemical processes is relatively low so that if a plant is being installed for a cracked gasoline it usually pays to enlarge the plant so that it can also handle the straightrun gasoline. In such a situation, the cost of handling the straightrun gasoline is very small. At the same time an increase of even 3 units of octane number (at 3 cc. TEL level) in a straightrun product may not be worth much because it may not suffice to raise the octane number of the final leaded product to a level suitable for even household brand gasoline.

If the values reported from the literature in tabulation form in the Questions on Technology and Refiner's Notebooks listed above are truly representative, the situation with respect to the chemical and the catalytic desulfurization processes is as shown in Table 1. Note that catalytic desulfurization is not applied to cracked gasolines. It is also worthy of note that the catalytically desulfurized stocks reported in the literature are generally quite low boiling.

Finally, we wish to point out that the data on Santa Maria cracked gasoline, reported on page 75 of Questions on Technology, December 22, 1945, are not correct. The data given there were for a mixture of reference fuel and Santa Maria gasoline. If the blending octane numbers are employed for the comparison rather than the octane numbers of the blend, the almost unheard-of improvement by Unisol desulfurization of 8.3 units of octane number is obtained for Santa Maria cracked gasoline.

TABLE 1

Oct. No. of stock	Oct. No. of desulfurized stock with 3 cc. TEL — Catalytic* on straightrun only	Chemical† — On low sulfur straightrun	Chemical† — On cracked
40	65.4 to 73.4	60.4 to 70.4	.....
45	68.6 to 76.6	63.9 to 73.9	.....
50	71.5 to 79.5	65.4 to 75.4	.....
55	74.6 to 82.6	71.1 to 81.1	.....
60	77.7 to 85.7	74.9 to 84.9	73.0 to 79.0
65	80.9 to 88.9	78.8 to 88.8	75.5 to 81.5
70	84.3 to 92.3	82.6	77.3 to 83.3
75	87.5	86.3	.....

*Average from The Refiner's Notebook No. 65, Oct. 27, 1945, based on Questions on Technology, Oct. 13, 1945. †Averages from Refiner's Notebooks Nos. 63 and 67, Oct. 13 and Nov. 10, 1945, for undesulfurized octane numbers with 3 cc. TEL, plus 2 units for cracked gasolines and 2.5 units for straightrun gasolines as indicated by Questions on Technology, Dec. 22, 1945.

Motor-Voltage Considerations In Petroleum Refineries

by E. Kun

This article discusses the practical limitation of motor sizes for the economical application of voltages. Accompanying tables contain approximate costs of materials for motors, control equipment, and wiring in oil refineries where a particular type of equipment must be used. The author is an electrical engineer with The Lummus Co.

THE selection of voltages for motors in oil refineries and similar industrial plants is commonly determined in accordance with rules and practices established for a number of years, and not on the basis of economy as affected by the latest developments in the arts and with consideration to supply system requirements.

Three-phase motors for 440 and 2,200-volt service are the types most frequently used, with a dividing line varying between 50 and 100 hp. with the different industrial plants. The reason for going to 2,200 volts for 100, 75, 60 and even 50-hp. motors is claimed to be saving in cables and conduit for the motor circuit, and a saving of transformer capacity when the usual 2,300-volt distribution system is available. In former times when 2,200-volt motor control equipment of standard type (N.E.M.A.—I enclosures), and low interrupting capacity could be used, a saving could be obtained by applying the higher voltage to motors of sizes under consideration. Today, however, due to the more or less universal requirements of the so-called "explosion proof" (Underwriters' Class I, Group D type) control equipment, and the higher interrupting capacities demanded by the electrical system, the use of the higher voltage, for sizes of motors up to and somewhat above 100 hp., usually results in a waste of money and space for control equipment.

Motor-driven pumps in large 100-octane aviation-gasoline plant, which was designed and built by The Lummus Co.

The purpose of this article is to determine the practical limitation of motor sizes for the economical application of voltages. Tables 1 and 2 contain approximate costs of materials which are representative figures for motors, control equipment and wiring in oil refineries, where "Class I, Group D" type equipment must be used. These figures should suffice from comparison, as labor costs are about proportional to costs of material.

Comparison of Tables 1 and 2 indicates that motors of sizes up to and including 125 hp. should definitely be for 440-volt service. In case of 150-hp. motors the figures indicate a slight saving in favor of the 2,200-volt motor. However, it must be remembered that the cost of motor feeders, incoming line equipment, etc., varies with local conditions, and the figures may vary slightly in favor of either voltage. The deciding factor should be, in this case, the higher maintenance of the high voltage control equipment, for which reason 440-volt equipment will prove more economical in the end, for 150-hp. motors. Twenty-two hundred volts should be selected for 200 hp. and above, with equipment such as included in the above tables.

There are two other types of 2,200-volt control equipment very often used in oil refineries. One is of switchboard-panel construction, employing a low-interrupting-type oil-immersed contactor with a set of high-interrupting capacity type, current-limiting fuses in disconnecting mounts. The cost of such equipment for semi-hazardous locations is approximately $1,650 list (including controller, disconnecting device, bus and interconnections) and, therefore, the above conclusions should also apply when such equipment is considered.

Another 2,200-volt control equipment is the so-called "Metal Clad" switchboard-panel type, employing oil circuit breakers of 50,000 kva. interrupting capacity, disconnectable by means of lowering device. The cost of such a panel is approximately $2,500 net (including controller, disconnecting device, bus, and interconnections) indicating that even 200-hp.

TABLE 1—440-VOLT EQUIPMENT

Horsepower—	60	75	100	125	150	200
Motor, 440-volt, 3-phase, 60-cycle, 1,800-r.p.m., squirrel-cage, explosion proof	$851	$986	$1,294	$1,660	$1,923	$2,456
Controller, 440-volt, combination type, oil immersed magnetic, across line, with circuit breaker, Class I, Group D, construction, including explosion-proof push-button station mounted at motor	410	410	410	850	850	850
440-volt enclosed bus and interconnections at controller assembly	53	57	64	108	112	135
Motor feeder (varnished cambric insulated, lead covered cables) also push-button pilot cable, including conduits and fittings for both, based on 100-ft. length	184	225	273	387	438	550
Estimated share of main 440-volt circuit breaker, and incoming service feeder	150	190	250	315	375	500
Estimated share of 2,400/480-volt transformer station	240	300	400	500	600	800
Total of all items	$1,888	$2,168	$2,691	$3,820	$4,298	$5,291

TABLE 2—2,200-VOLT EQUIPMENT

Horsepower—	60	75	100	125	150	200
Motor, 2,200-volt, 3-phase, 60-cycle, 1,800-r.p.m., squirrel-cage, explosion proof	$972	$1,107	$1,385	$1,746	$2,005	$2,514
Controller, 2,200-volt, oil immersed, magnetic, across line, with 50,000 kva. interrupting rating Class I, Group D construction, including explosion-proof push-button station mounted at motor	1,340	1,340	1,340	1,340	1,340	1,340
Disconnecting switch, 3-pole, oil immersed, 5 kv. or 7.5 kv. rated	205	205	205	205	205	205
2,200-volt bus and interconnections at controller assembly	160	160	160	160	160	165
Motor feeder, (varnished cambric insulated, lead covered cables) also push-button pilot cable, including conduits and fittings for both, based on 100-ft. length	195	195	195	195	195	235
Estimated share of main 2,200-volt incoming line panel and incoming service feeder	250	250	300	300	300	350
Total of all items	$3,122	$3,257	$3,585	$3,946	$4,205	$4,809

motors should be for 440-volt service for economy, where such 2,200-volt equipment must be used.

An analysis, similar to the above, but based on standard industrial equipment, was presented in a recent issue of General Electric Review, by D. L. Beeman of the Industrial Engineering Division, General Electric Co. ("Industrial Power Systems," pages 17 to 20, inclusive, April 1945). Beeman's conclusions are that "for motors less than about 200-hp. rating, reference to curves . . . will show that 440-volt motors make possible the least investment in the electric equipment, regardless of primary voltage. Thus, all motors rated about 200 hp. or less should be operated in systems rated 600 volts or less, regardless of the primary voltage selected." He also states that "the effect of explosion-proof requirements will have little bearing on the basic factors . . .," which statement coincides with the analysis presented in this article.

Beeman further states that "where a choice of primary voltage can be made, it is usually more economical to select 4,160 volts than 2,400 volts—even where the percentage of motors above 200 hp. is as high as 50 to 60 per cent of the total plant load."

As a rule, oil refineries use 2,300 or 2,400-volt systems with 2,200 or 2,300-volt motors for the larger sizes. Motors for 4,160 volts are somewhat more expensive than for 2,200 volts. The present approximate costs of 4,160-volt, 3-phase, 60-cycle, 1,800-r.p.m., squirred-cage, explosion-proof motors are:

75 hp.	$1,550
100 hp.	1,950
125 hp.	2,360
150 hp.	2,560
200 hp.	2,960

The cost of control equipment and other items, for 4,160-volt service is about the same as those given in Table 2. Therefore, in a new development where the choice between 2,300 and 4,160-volt distribution is not impeded by consideration for existing installation, the choice can be based on the saving in the distribution system effected by the use of the higher voltage, as against the higher cost of the 4,160-volt motors.

S. B. Severson, formerly vice president and general manager of the Dominion Natural Gas Co., has been elected president and general manager. **John R. Reeves,** general superintendent, succeeds Severson as vice president.

W. L. Cowan, Union Oil Co. of California, has been transferred from the process engineer's department at Santa Fe Springs, Calif., to the Los Angeles office where he will be liquefied petroleum gas coordinator for the company.

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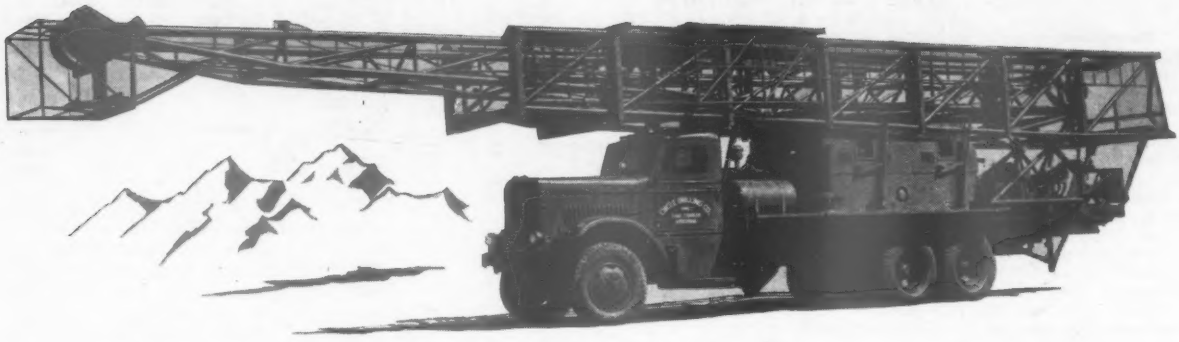

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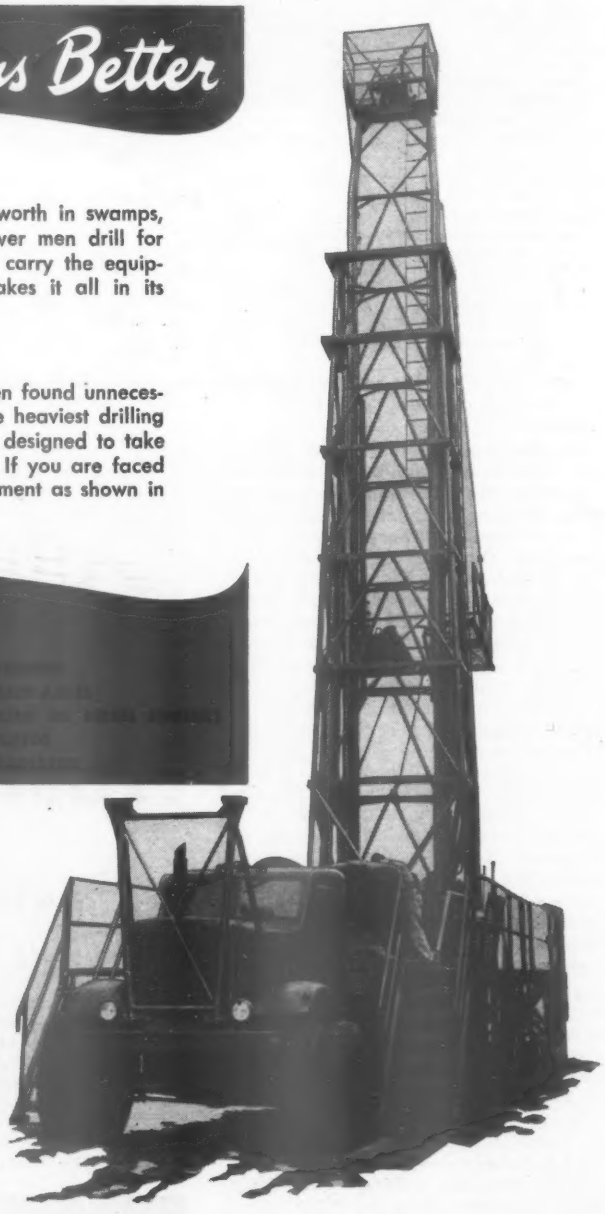

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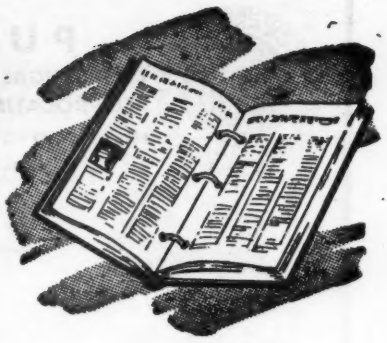
The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL



Routing of Fluids

NO fixed rule can be given about which fluid to pass through the shell and which through the tubes. The particular conditions under which each exchanger operates govern this selection. Among important considerations (consider both fluids) are viscosity, film transfer rate, pressure, allowable pressure drop, amount of fluid, cleanliness, and tendency to cause corrosion. Obviously, these factors are frequently at variance with one another and hence the final selection may be a compromise which meets one requirement well but may be only partially successful in meeting others. The decision is sometimes so difficult that one cannot be certain that the final decision was the best one. In the discussion which follows, the factors that are at variance with one another are placed close together so that the conflict can be observed.

1. **High-pressure** fluids should be passed through the tubes because even thin tubes are strong whereas special shells are required if the pressure exceeds 125-150 psi.

2. **Dirty stocks** should flow through the tubes because they can be cleaned more easily, and this is imperative in exchangers in which the tube bundle cannot be removed for cleaning.

3. **Dirty stocks** carrying large amounts of coke or sediment should pass through the shell so that adequate space for accumulation of the debris is available; **but** provide a construction that allows ready access for dumping the shell and cleaning the outside of the tubes. Fig. 1 indicates such a construction.

4. **Dirty stocks** must be sent through the shell if the inside of the tubes cannot be easily cleaned, as is the situation with U-Tube or hairpin tube bundles. (Fig. 4, Refiner's Notebook No. 80, February 12.)

5. **Corrosive stocks** should be sent through the tubes because they can be easily cleaned and because corrosion-resistant tubes are cheaper than corrosion-resistant shells.

6. **Water,** because of its scale-forming tendency, should usually be sent through the tubes.

7. **Large-volume** fluids such as condensing vapors, usually are passed through the shell so that velocity and pressure drop will not be excessive.

8. **Small-volume** fluids are also sent through the shell where, by the use of many cross baffles, a high rate of heat transfer is produced without excessive pressure drop.

9. Vapor containing **noncondensable gases** should be sent through the tubes so that the gas will not accumulate in stagnant areas of the equipment and reduce the transfer rate.

10. If the **pressure drop** must be low, pass the material through the shell. Examples are vacuum condensers, and usually sidestream products from topping or atmospheric towers.

11. **Viscous** fluids are passed through the shell where cross baffles will improve the transfer rate with a minimum friction loss.

12. **Fluids of low film rate** in fin-tube equipment are passed through the shell or around the tubes where the large area of the fins can compensate for the low film rate.

13. **High-pressure, dirty, or corrosive fluids** in fin tube equipment are passed through the tubes so that thin tubes will suffice, dirt can be cleaned from the tubes, and the tubes can be replaced at little expense if they fail by corrosion.

14. The **hottest fluid** is passed through the tubes so that heat loss to the surroundings is minimized. This is usually of little practical importance in properly insulated equipment.

Thus in a topping plant the crude oil would normally flow through the tubes of all of the exchangers except possibly the topped crude exchanger —so that adequate vapor space is available for gasoline vapor on the shell-side of the gasoline condenser exchanger, so that the side-draw products (under little pressure) can flow through the exchangers and coolers to storage without pumps, and through the shell of the topped-crude exchanger (unless the pressure is high) so that dirt from the topped crude oil can easily be cleaned from the tubes.

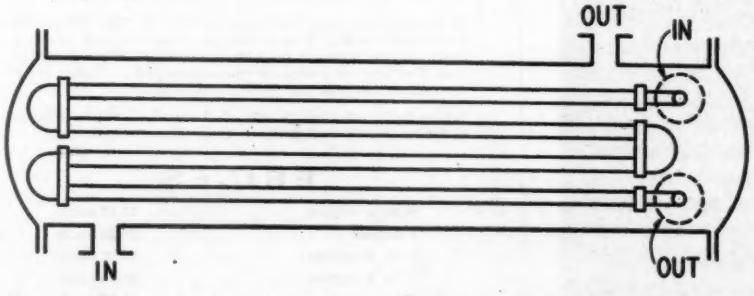


Fig. 1—Tubes connected by return bends and housed in a shell for use on transfer lines, vapor from cracking-plant evaporation, or for the accumulation of debris in the shell

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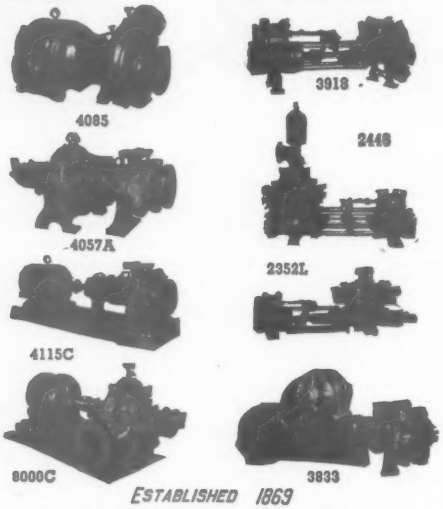

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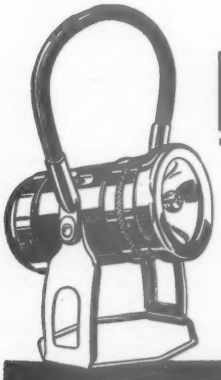

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THE OIL AND GAS JOURNAL
Tulsa 1, Oklahoma

Engineering Fundamentals

No. 224

A FEATURE OF THE OIL AND GAS JOURNAL

Petroleum Reservoirs That Consist of Convex Traps

THIS installment of Engineering Fundamentals, and the next several installments, continue the discussion on "Classification of Petroleum Reservoirs," which began in last week's issue, page 171. The system of classification described was devised by Dr. O. Wilhelm, of the production department of Shell Oil Co., Inc., and first appeared in the November 1945, A.A.P.G. Bulletin. It is an entirely new approach to the problem and is derived by combining in various ways the sets of geological factors, or trap-forming factors, which cause the trapping of petroleum.

THE many thousands of producing oil pools all divide up into a relatively few different types. In studying an individual oil pool, there are two standpoints to consider, one narrow and one broad. Both are important. The broad viewpoint is the type of geologic structure which brought about the concentration of the oil or gas. The narrow viewpoint is the particular trap in which the reservoir is located. These two basic elements, one broad and general and the other specifically and sharply detailed, can combine in many ways.

A convex or inverted-bowl-shaped surface of porous strata is a primary type of trap. Accumulations of oil and gas in such a trap make convex trap reservoirs. They have an uninterrupted edge water entirely surrounding the oil reservoir, because the porosity is unrestricted in all directions beyond the oil saturated area. The group of convex trap reservoirs is divided into

Simple convex trap reservoirs
Composite convex trap reservoirs
Complex convex trap reservoirs.

Simple convex trap reservoirs.—This group has a simple convex surface that may be caused by structural deformation; or by combination of structural deformation and differential (varying) thickness in porosity conditions; or by differential porosity alone. The differential porosity may be due to such phenomena as irregularity in depositional thickness of a porous bed; to progressive lateral change from permeable to impermeable zones, as from sand to silt or shale; to differential cementation, or in limestone reservoirs, to differential solution.

Fig. 1 shows the entire series of fundamental types located on the different type structures, as indicated by the contours. Reservoir 1, the 100 per cent structural type of this group, is restricted to the culminations of anticlines or domes. In contrast, the convexity in the surface of Reservoir 6, the 100 per cent stratigraphic type, is entirely the result of differential thickness in the reservoir bed. This reservoir can occur in an area showing no structural deformation whatsoever.

In the intermediate types, 2 to 5,

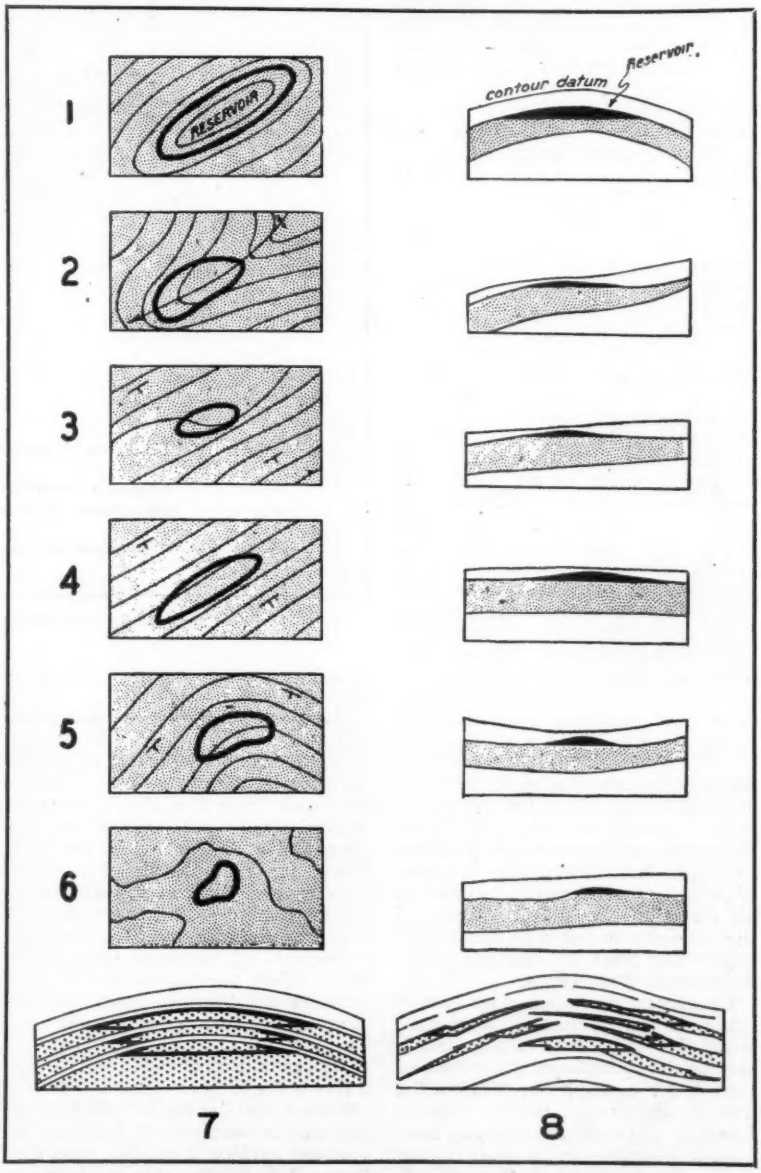

Fig. 1—Simple convex trap reservoirs (in plan and NE-SW longitudinal section)

located on salient, terrace, monoclinal, and synclinal type structures, respectively, structural and stratigraphic control are reciprocal. In the salient and terrace types, 2 and 3, the top of the reservoir rises stratigraphically in down-structure direction, and this, together with the available structural bending, provides the convex reservoir surface. The 4,300-ft. pay in the Hull-Silk field, Archer County, Texas, is an example of Type 2. In the monoclinal type, 4, the structural influence is reduced to tilting, and porosity must "build up" along the strike as well as in the downdip direction to make this reservoir possible. In the synclinal type, 5, the structural contribution is reduced still further and the convex surface of the reservoir is due to a stratigraphic rise in porosity from nearly all directions.

Reservoir 1 is the classical anticlinal type. Reservoirs 2 to 5 are typical for areas of gentle warping where the low rate of dip can be overcome by the rate of differential thickening in the reservoir beds. Reservoirs 4, 5, and 6 receive little attention in the systematic search for petroleum reserves, because of the lack of adequate exploration methods for locating these types. Nevertheless, in areas where irregular thickness of strata is typical, as, for instance, in sequences that originated from near-shore deposition, the chances of finding simple convex trap reservoirs in monoclinal and synclinal structural environments of low relief should be quite fair. At present, however, only the most comprehensive coordination of all stratigraphic and regional criteria can lead to the discovery of such reservoirs. Numerous limestone reservoirs, including types with solution porosity, belong in the convex trap group. In fact, secondary porosity in massive zones of limestone and in areas of low structural relief is apt to give rise to any type of convex trap reservoirs. To identify them with this group, the zone of porosity must, however, extend in all directions beyond the limits of the reservoir to permit a continuous edge-water limit, for example, Goldsmith field, West Texas.

Cavernous limestone reefs, whose origin is not necessarily connected with the structure, display many spectacular petroleum reservoirs of type 6, for example, in Mexico, the Tampico-Southern fields (Golden Lane) at the crest of a barrier reef.

Also, reservoirs in the apex of cavernous cap rock of shallow pierce-

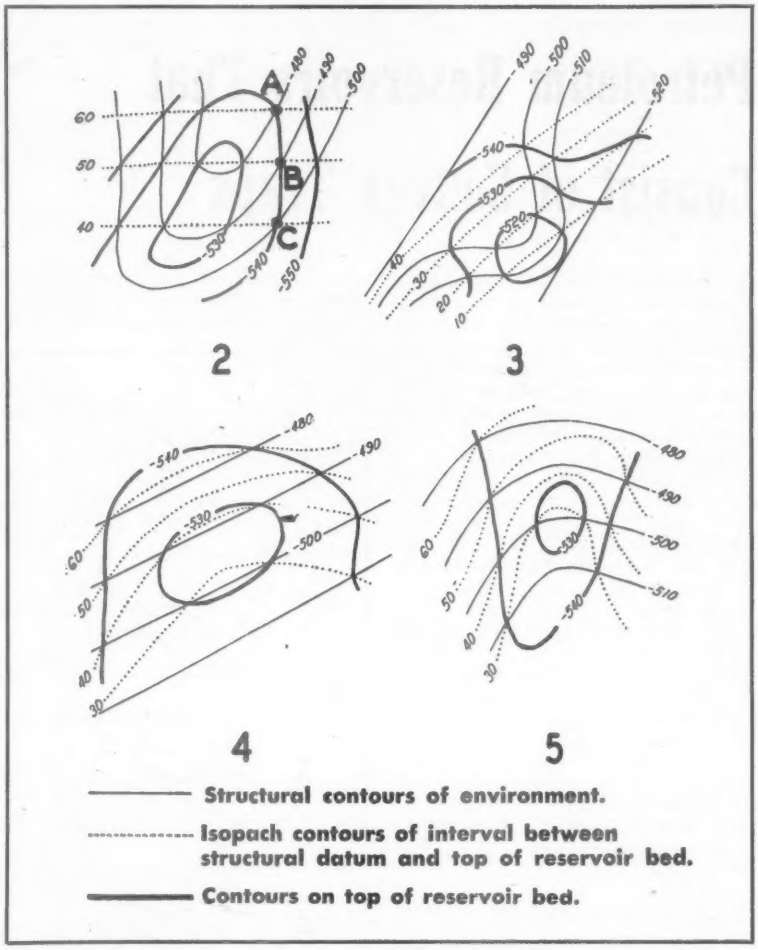

Fig. 2—Subsurface relation of convex trap reservoirs

ment-type salt domes are in the convex trap group.

Composite convex trap reservoirs.—This sub-group includes convex trap reservoirs which extend across several structural units. These, shown as Type 7 in Fig. 1, are particularly well represented on the deep-seated salt domes of the Gulf Coast, for example, the Eola field.

Complex convex trap reservoirs.—These reservoirs, illustrated as Type 8 in Fig. 1, are productive intervals composed of separate productive units. They are typical for the Los Angeles and Ventura basins in California, for example, Santa Fe Springs and Long Beach fields.

Determination of field limits.—Fig. 2 shows the kind of relation between structure and the top of the reservoir bed that is necessary to produce the convex surface for the reservoir Types 2 to 5. The thin contours in each example are the subsurface contours of the structural environment, and the dotted lines are isopach contours of the interval between the structural marker and the top of the reservoir bed or the top of porosity. The heavy contours, the resulting subsurface contours on the top of the reservoir, show the area of closure. Note that the interval between the structural contours and the top of the reservoir bed has to decrease in a downdip direction to effect such closure. For example, at Point A on the illustration of Type 2, the interval between the structural contours and the top of the reservoir bed is 60 ft., while at Point B it is 50 ft. and at Point C it is only 40 ft. During the development period, this graphic procedure is a convenient method of determining the position of these reservoirs relative to structure, and to forecast their limits.

OIL AND GAS EQUIPMENT Digest

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by Joe Cahill

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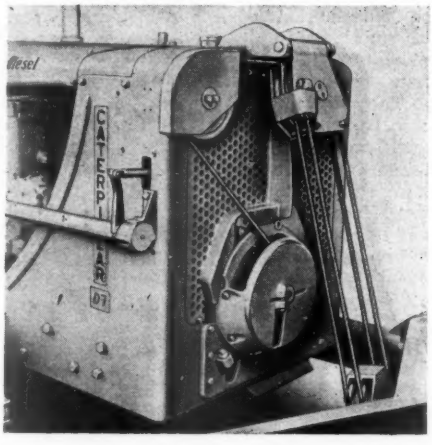
IT'S NEW CHECK IT

(2) NEW CABLE CONTROL UNIT. Production of a new single-drum, front-mounted cable control embodying the multiple-disk-type clutch, whose line pulls are ample to meet the most severe service requirements imposed by bulldozer operation, has just been announced. Drum diameter is 9 in., length 2½ in., and drum flange diameter 14 in. The cable size is ½ in. Drum capacity 75 ft. and the clutch has 12 friction surfaces with an area of 564 sq. in. Controls respond quickly to give accurate, powerful control with a minimum of operating effort. Design permits rapid free spooling when desired. The unit is readily accessible for adjustments, and the control lever is placed to insure a minimum of operator strain. *Caterpillar Tractor Co.*



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(3) PRESSURE-SEAL WIRE-LINE VALVE is designed for use wherever tools or instruments are run in wells under pressure. Installed below the lubricator has a built-in equalizing valve which seats ram tighter when higher pressures are applied. Saves time when multiple runs are made. May be used to shut in the well when stuffing box on the lubricator fails. Tested to 6,000 lb. the valve has a full 2½-in. opening and weighs approximately 100 lb. *Oilfield Machinery & Supply.*

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(4) PIPE SEALING AND GASKET COMPOUND forms a permanent seal, yet retains enough flexibility to permit expansion and contraction without cracking. Does not become brittle with age. Complete insolubility in oils makes it very useful in pump and tank work, bulk storage and refinery piping, field applications. *Bowser, Inc.*

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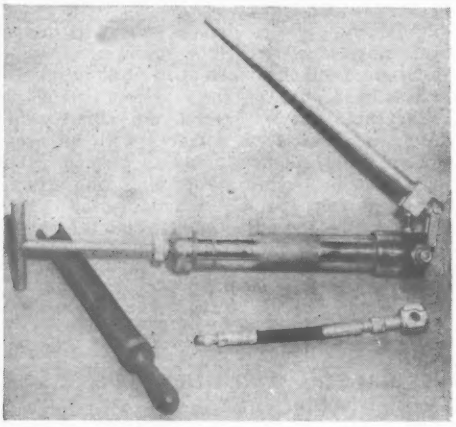
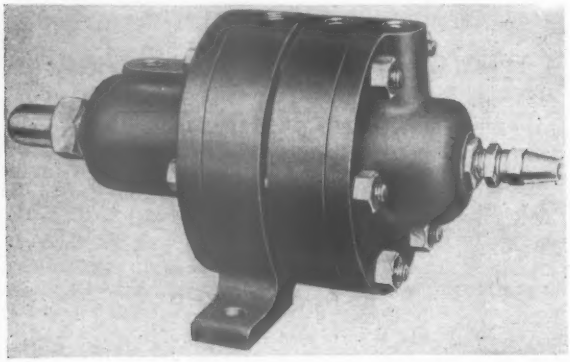
(5) NEW METHODS OF VALVE LUBRICATION make it possible to lubricate 15 or 20 valves while 1 is being done by the old screw method. Inventory stock of lubricant can be reduced from 8 or 10 numbers to maximum of 3. No. 1002 is a high-pressure gun with a maximum pressure of 10,000 lb. and No. 1001 with maximum pressure of



5,000 lb. but with a volume of 3 times the 10,000-lb. gun, the difference being in the piston ratio. These guns have a screw prime plunger assembly with a special neoprene cup and a long heavily constructed handle to give maximum leverage. *Delta Engineering Sales Co.*

IT'S NEW CHECK IT

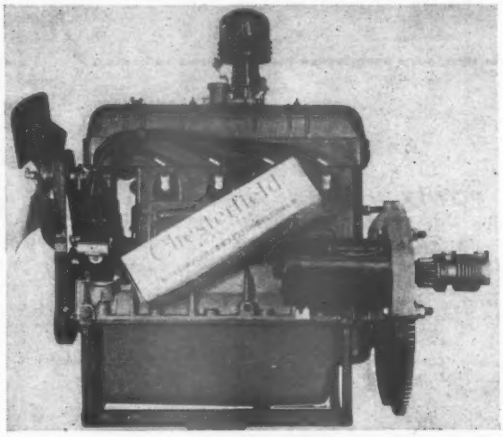
(6) TYPE F TOTALIZER, a new pilot-operated, pneumatic relay, is used to add or subtract loading pressures received from external sources. Can also be used as a regulator. In a control system, its function depends upon the manner in which loading pressures are applied to the several diaphragms. Will effect a reproducible change in outgoing loading pressure on as little as 0.1 per cent



change in incoming loading when the output loading pressure is at maximum. May be used in connection with a measuring flow element and a power unit to regulate fluid flow, temperature, pressure, level, speed, or any other physical condition that can be transformed into a loading pressure as an indication of magnitude. *Hagan Corp.*

IT'S NEW CHECK IT

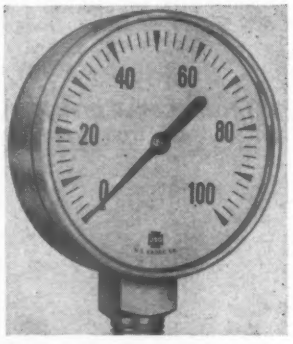
(7) LIGHT-WEIGHT SHEET-METAL ENGINE made entirely from sheet-metal stampings and furnace brazed weighs only 14.8 lb. before machining. Rigorously tested in high-speed generator sets by the Navy, it is now being used as the motive power in a new lightweight automobile. Delivers 26 hp. at 5,200 r.p.m with a compression



ratio of 7.5 to 1. Cylinder displacement is 44 cu. in. with a 2½-in. bore by 2¼-in. stroke. Complete engine with all accessories including generator and starter weighs only 138 lb. Illustration shows its size compared to a carton of cigarettes. *Crosley Motors, Inc.*

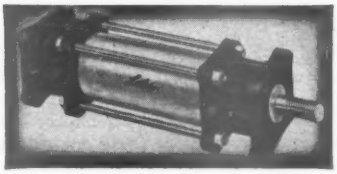
IT'S NEW CHECK IT

(8) NEW LINE OF STREAMLINED GAGES in a modernized, eye-appealing design. Engineers, working hand-in-hand with designers, have succeeded in developing gages superior in construction, appearance, and readability, while retaining precision. The working parts are the culmination of years of experience in instrument engineering and new-materials research. The streamlines of the neutral gray case are heightened by an ivory-toned dial with contrasting red and black gradations. Manufacturer claims longer life under adverse conditions for its smart new group of gages. *U. S. Gauge Div.*



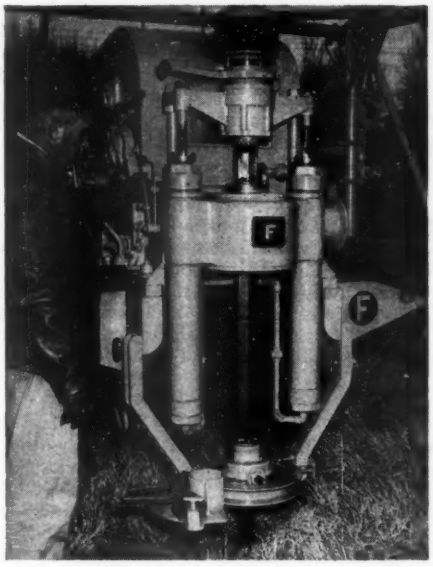
IT'S NEW CHECK IT

(9) A STANDARDIZED CYLINDER for operation by air, oil, or water, which lends itself to almost universal mounting applications, has been announced. Completely standardized, it is manufactured in quantities, and is available off the shelf in an assortment of diameters and stroke lengths that meet practically all requirements. *Engineering Products Co.*



IT'S NEW CHECK IT

(10) A NEW SWINGING SPIDER arrangement on portable drills for holding the drill pipe while making it up or breaking it out, has been announced. Designed to handle up to 400 ft. of N drill pipe, it saves considerable time in setting up since it eliminates the need for leveling or



aligning required with the conventional foot clamp or spider. The frame is fastened permanently to the bed of the truck on a hinge and locks down in place for drilling operations or up for road travel. The spider bowl also is hinged and swings horizontally away from the hole easily and quickly while drilling or setting large-diameter surface pipe. *Geo. E. Failing Supply Co.*

IT'S NEW CHECK IT

(11) NEW OIL-FIELD PUMPING CONTROL combines circuit protection and motor control in a single unit to save space and wiring. Especially designed to provide for the automatic starting and stopping of oil field pumping motors. Weather-proof enclosure permits outdoor, pole-mounting close to the load. The dead front inner door protects the operator from live parts, when cabinet door is opened. Available in two basic types, providing overload and low voltage protection. The automatic unit includes AB breaker, "De-ion" linestarter, lightning arrester, hand reset low voltage relay, "Hand-Off-Automatic" selector switch to permit manual operation, socket and time switch. The time switch automatically controls specific pumping periods during the day. The local control unit includes AB breaker, "De-ion" linestarter, lightning arrester, and Start-Stop pushbutton. Ratings are from 1 to 25 hp., 110, 220, 440-600 volts. *Westinghouse Electric Corp.*

IT'S NEW CHECK IT

(12) SLUSH-PUMP LINERS, made of tool steel by a special process, and particularly adaptable where abrasive conditions are most severe. Liners are honed and ground. Hardness of material, and depth of hardness, are particular features. *Tool Steel Gear & Pinion Co.*

IT'S NEW CHECK IT

(13) TWO NEW WELD-SPATTER-RESISTANT COMPOUNDS are specially formulated for use wherever weld spatter is undesirable and must be avoided easily and economically. Furnished in powder form, ready to be mixed with water, the compounds are identical in performance. One is nonadherent and can be readily removed with an air hose or a dry cloth, while the other is semiadherent but can be quickly and easily removed with a damp cloth or a direct stream of water. Surface of the work, even if slightly oily, does not require wetting before compound can be applied. Special ingredient in the compounds eliminates the necessity of a water-soluble binder in order to obtain adhesion. Completely smokeless. One gallon of either will adequately cover 450 to 750 sq. ft. of work, depending upon the thickness with which the compound is applied. *General Electric Co.*

IT'S NEW CHECK IT

(14) TWELVE-EQUATION ELECTRICAL COMPUTER was developed to fill the increasingly urgent need for a fast, accurate method of solving linear simultaneous equations and provides the means for the rapid and accurate solution of any number of simultaneous equations up to and including 12. Based upon the "Gauss-Seidel" or "Classical Iterative" method, it is capable of maintaining consistent accuracy. Each step consists of adjusting circuit to a balance condition or null, with the instrument itself "remembering" the previous approximation as long as necessary. Originally developed for mass spectrometer and infra-red data, the usefulness extends to any other field of application involving linear simultaneous equations, such as the study of electrical circuits, structures, aircraft flutter analysis and statistics, and is of real value to many industrial and scientific groups for solving problems otherwise too arduous and time consuming. *Consolidated Engineering Corp.*

IT'S NEW CHECK IT

TRADE LITERATURE

(15) WATER SEPARATOR AND FILTER. Separation problems for refineries, pipe lines, and gasoline plants are covered in new pamphlet. Flow sheets and installation photographs show this manufacturer's separators under operating conditions. *Flotrol Systems, Inc.*

IT'S NEW ✓ CHECK IT

(16) SLUSH PUMPS. Ring-punched, color-printed bulletin gives specifications and operating charts for this manufacturer's line of slush pumps. Cutaway drawings fully illustrate construction and installation suggestions. *Emsco Derrick & Equipment Co.*

IT'S NEW ✓ CHECK IT

(17) WELDING ELECTRODE PROPERTIES. New chart, valuable in the shop as well as engineering office, contains tremendous amount of welding data clearly condensed and arranged for easy factfinding. May be hung on the wall or filed in a desk drawer. *Page Steel & Wire, Div., American Chain & Cable Co.*

IT'S NEW ✓ CHECK IT

(18) FIVE NEW STRAIGHT CHROMIUM STAINLESS STEELS are described in four-page pamphlet giving specifications of each. Physical properties, strength analyses, and suggested heat treatments are included. *Lebanon Steel Foundry.*

IT'S NEW ✓ CHECK IT

(19) ENGINE-DRIVEN COMPRESSORS is the subject of this extremely informative bulletin. Its 48 pages contain many operational and control diagrams, bisected views, and sectional drawings. Detailed explanations and a lot of instructive pictures and descriptive material are included. Even if you don't want a compressor you'll find this interesting and instructive. *Cooper-Bessemer Corp.*

IT'S NEW ✓ CHECK IT

(20) DESIGNED FOR THE JOB is the title of a new pamphlet describing this company's U-15 rotary drilling unit. This release is extremely interesting from the standpoint of the wealth of engineering information contained in its 16 pages. Well illustrated with pictures and line drawings it covers fully the specifications and performance of this rig. Gives tables of line speeds, etc., and charts of mud pump characteristics. *Unit Rig & Equipment Co.*

IT'S NEW ✓ CHECK IT

(21) LIQUEFIED GAS CYLINDERS. A 4-page bulletin describes high-pressure cylinders manufactured for transportation and storage of liquefied petroleum gases. Specifications and drawings of some sizes are given. *Pressed Steel Tank Co.*

IT'S NEW ✓ CHECK IT

(22) PLANE PORTRAITS. A 28-page booklet, illustrated in color, contains a series of articles published by the editors of Air Tech magazine as a service to the aviation industry and in recognition of the growing importance of chemistry in the care and maintenance of aircraft. The chemical processes and materials described in Plane Portraits are now available to help in solving such production and maintenance problems as corrosion prevention, paint removal, the preparation of aluminum surfaces, engine overhaul, surface coatings, the cleaning of transparent plastics. In addition to the technical data, Plane Portraits also contains 8 by 11-in. photographs, in full color, of popular planes. *Turco Products, Inc.*

IT'S NEW ✓ CHECK IT

(23) CONCRETE FLOORS, a new, 13-page booklet outlines a method of replacing wornout floors over a single weekend. Published with the thought that innumerable concrete floors need replacing after hard wartime service, the suggestions contained in it will be helpful to anyone needing floor replacement to put plants back into full efficient service. *Lone Star Cement Corp.*

IT'S NEW ✓ CHECK IT

(24) PACKAGED AIR CONDITIONING for all domestic and commercial installations is covered in loose-leaf file-folder-type booklet. Sample floor plans as well as specification sheets for 3 and 5-hp. sizes are included. Isometric drawings show how these installations can be made in practically any new or remodeled building. *Airtemp Div., Chrysler Corp.*

IT'S NEW ✓ CHECK IT

(25) QUONSET HUTS redesigned for peacetime service. New series of illustrative booklets just released by the manufacturer of these famous steel buildings show complete line of prefabricated structures as well as floor plans, erection diagrams, and the nailable framing for conventional buildings. *Great Lakes Steel Corp.*

IT'S NEW ✓ CHECK IT

(26) GERMAN FASTENERS INDUSTRY is a bound report of the investigations made in Germany by Roy Harmon Smith and Charles F. Newpher and reported to the Technical Industrial Intelligence Committee of FEA. Covers methods of manufacture, individual firm reports and random observations of these two men. Extremely interesting to the engineer and all laymen interested in machining operations. *American Institute of Bolt, Nut & Rivet Manufacturers.*

IT'S NEW ✓ CHECK IT

(27) FLEXILASTICS, the products which are more than rubber, are highly developed compounds of natural and synthetic rubber, chemicals, pigments, fillers, etc., processed into an homogeneous unit. In comprehensive language this bulletin describes these products, their composition, and uses. Well illustrated. *Raybestos-Manhattan, Inc.*

IT'S NEW ✓ CHECK IT

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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Natural Gas

Shiprock Helium Plant Goes on Stand-by Basis

WASHINGTON.—As a natural gas conservation measure, cutbacks in the nation's helium production will result in continuing operations at the Exell plant near Amarillo and maintaining the Shiprock, N. M., plant in a shutdown, stand-by condition.

Bureau of Mines officials explained that helium processed by Exell is produced with natural gas and the helium it contains would otherwise be wasted. Helium reserves at Shiprock, on the other hand, can remain in the ground indefinitely.

The warbuilt Shiprock plant will be kept in a state of readiness, and machinery will be tested each week by an engineer in charge. Production from the Exell plant is sufficient to meet all current needs, bureau officials said.

Knapp Appointed Assistant Head of Gas Laboratories

NEW YORK.—Kenneth R. Knapp, since 1930 chief engineer of the American Gas Association's testing laboratories, has been advanced to assistant director.

Knapp spent 18 years as an engineer with the United Gas Improvement Co. before joining A.G.A. in 1929 to take charge of pipe-line research.

Tracht Made Treasurer In United Gas Changes

SHREVEPORT.—L. V. Tracht, assistant treasurer of United Gas Corp.'s operating division in Houston for 9 years, has been made treasurer of the corporation in a series of personnel shifts.

Tracht will be succeeded in Houston by A. J. Biard. R. E. Hull was advanced to comptroller of the corporation and its three subsidiaries, United Gas Pipe Line Co., Union Producing Co. and United Oil Pipe Line Co. He will be succeeded as general auditor by F. E. Waltrip, former assistant general auditor. J. H. Miracle, who has been secretary of the subsidiary companies, was given the additional post of secretary of the parent corporation. Other personnel changes included four promotions: M. V. Cousins, to director of personnel; D. R. Pflug, to assistant chief engineer; H. W. Egger, to superintendent of compressor stations; and H. W. Eiser, to superintendent of transportation for the three subsidiaries.

Commission Motion Asks Hearing on Mexico Line

AUSTIN.—Texas' attorney general has drafted a motion which will allow the Texas Railroad Commission to reiterate its opposition to an application before the Federal Power Commission for the export of natural gas into Mexico.

The FPC has once turned down the proposal of Reynosa Pipeline Co. for a line from Hidalgo County fields to the border where it would be carried on to Monterrey. A rehearing in the case, however, has been granted.

Two members of the Railroad Commission, Beauford Jester and Olin Culberson, announced in Houston they will continue to fight the project. The motion asserts insufficient gas for the line will remain after the proposed Carthage Hydrocol, Inc., synthetic gasoline plant near Brownsville begins operation.

Month's Gas Allowable Set for Kansas Field

WICHITA.—February allowed production from Kansas' seven-county Hugoton field has been set at 9,086,551,000 cu. ft. by the State Corporation Commission.

The commission's conservation division found market demand as nominated at 9,641,900,000 cu. ft. but deducted 555,349,000 cu. ft. in accumulated underproduction from January. January runs of gas totaling 9,677,824,000 cu. ft. were shown in the report. Twenty-seven new wells were listed to bring the field's total to 554.

Here are shown the members of the newly elected board of the American Gas Association. Seated: Maj. T. J. Strickler, Kansas City Gas Co.; Charles M. Cohn, Consolidated Gas Electric Light & Power Co. of Baltimore; Kurwin R. Boyes, secretary, A.G.A.; R. H. Hargrove, United Gas Pipe Line Co., vice president, A.G.A.; Gladys Hanshaw, A.G.A.; Everett J. Boothby, Washington Gas Light Co., president, A.G.A.; Col. Hudson W. Reed, Philadelphia Gas Works Co., vice president, A. G. A. Standing: Randall J. LeBouef, Jr., counsel, A.G.A.; H. Leigh Whitelaw, managing director, G.A.M.A.; Lyle C. Harvey, Bryant Heater Co., president, G.A.M.A.; R. M. Conner, director, A.G.A. Testing Laboratories; Edward P. Noppel, Ebasco Services, Inc., chairman A.G.A. coordinating committee on research; Henry H. Morse, Florence Stove Co.; Henry Fink, Michigan Consolidated Gas Co.; Earl H. Eacker, Boston Consolidated Gas Co.; Dorr P. Harison, Equitable Gas Co., chairman, national advertising committee, A.G.A.; C. S. Goldsmith, Brooklyn Union Gas Co.; Norton McKean, American Meter Co.; Alvan H. Stack, Tampa Gas Co.; John J. Quinn, Boston Consolidated Gas Co., chairman, residential gas section, A.G.A.; Joseph N. Greene, Alabama Gas Co., chairman, membership committee, A.G.A.; Frank H. Adams, Surface Combustion Co., chairman, manufacturers' section, A.G.A.; George E. Whitwell, Philadelphia Electric Co., chairman, laboratories managing committee, A.G.A.; H. Carl Wolf, managing director, A.G.A.

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REFINING

Refinery at Oil City, Pa. Offered for Sale by U. S.

WASHINGTON.—A two-unit high-octane refinery operated during the war by Pennzoil Co., at Oil City, Pa., has been placed on the surplus property sale list by War Assets Corporation.

Offers for the property are being solicited by the agency. The refinery covers about 8½ acres and consists of a 1,500-bbl. daily capacity hydrofluoric acid alkylation unit and an 850-bbl. daily capacity gas concentration unit together with tankage for 123,000 bbl. at atmospheric pressure.

Ethyl Plans Courses for Men Back From Service

DETROIT.—Field engineers and research laboratory staff members of Ethyl Corp. who have returned from war service will be brought up to date on technical developments in a series of refresher courses to be conducted in the corporation's research laboratories here under the direction of Raymond R. Faller.

Though primarily from those who have been in service, the courses also will be open to other members of the technical staff. Faller is manager of employe relations at the Detroit laboratories. He recently was placed on inactive duty after service as a Navy lieutenant commander. The refresher series, each of 2 weeks' duration, are planned to begin soon.

Chemists' Meeting to Draw Many Oil Representatives

NEW YORK. — Discussions of the important future of chemistry in the petroleum field forms a part of the program of the 109th annual meeting of the American Chemical Society which will draw an estimated 10,000 chemists, engineers and industrialists to Atlantic City April 8-12.

Though a survey of nucleonics dealing with the release of atomic energy headlines the program, peacetime application of many other wartime advances will be discussed. Developments in plastics, petroleum, rubber, gas and fuel, and other materials will be reported in numerous papers. The first session April 9 will be devoted to a special discussion of the physical chemistry of copolymers and copolymerization. More than 100 of the society's 109 local sections will be represented at the meeting with several divisions, including the petroleum chemistry division, convening concurrently.

Refiners to Hear of Texas, Business Outlook, Japan

Japan's oil installations will be described by A. J. Pettigrove, member of a petroleum mission recently sent to the Far East, before members of the Western Petroleum Refiners Association at their thirty-fourth annual and first postwar meeting in Fort Worth March 25-27.

Pettigrove, who is associated with Stanolind Oil & Gas Co., and previously with Associated Refineries, Inc., and Phillips Petroleum Co., will speak the afternoon of March 27. Technical sessions are scheduled at 9:30 a.m., and general sessions at 2 p.m. March 26-27, with all meetings in the Blackstone Hotel.

R. R. Wason, president of the National Association of Manufacturers, will outline future manufacturing prospects at the Tuesday afternoon meeting. Chairman for this session will be Roland V. Rodman, vice president of Bay Petroleum Co. E. O. Thompson, Texas railroad commissioner, will give the address of welcome.

Another program feature will be a talk by Robert Ash, Washington, on

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"Tax Prospects in 1946." Entertainment events will include a buffet supper given by Ethyl Corp. Monday night and a buffet dinner and annual spring roundup party Tuesday by supply and transportation companies serving the refining industry.

Nebraska Plant Bought; New Company Projected

SALEM, Neb.—The Nebraska Producing & Refining Co. plant here of 5,000 bbl. skimming capacity has been bought by a group of four oil men who are planning to reorganize the company as the Oil Marketing & Refining, Inc. of Salem.

Purchasers are J. R. Watt, Meyer Moran, and A. M. Stekoll, all of Tulsa, and John Peters, Salem. The transaction also included producing leases in the Falls City and Dawson pools of Richardson County, southeastern Nebraska.

Tractor fuel, diesel, kerosene, and other byproducts from the Nebraska plant will be marketed by the new company in Nebraska, Iowa and adjacent states, the group announced. The three Tulsa men last year bought the Ohio Oil Co. properties in the Fall City field, and between 20 and 40 undrilled locations remaining will now be included in the enlarged Oil Marketing and Refining, Inc.

Desalting Plant to Be Built

LOS ANGELES.—Union Oil Co. has let contract for construction of a desalting plant to be erected at Santa Maria Valley. Cost will be approximately $500,000. The plant will remove undesirable salts common to Santa Maria Valley crudes before delivery to Union's refining facilities.

Report Urges Operation of A Third of Rubber Plants

WASHINGTON.—Much of America's war-built synthetic-rubber industry will be continued in operation if recommendations contained in the forthcoming interagency policy committee report are accepted.

Though still surrounded by secrecy, the report is understood to back the strong stand of the military that at least one-third of synthetic-rubber capacity be retained in peacetime operation, preferably by private industry.

The committee representing eight interested federal agencies is expected to deliver its policy report soon to John Snyder, reconversion director. Eventually, it is expected to find its way to the White House to form the basis for recommended legislation on the nation's rubber-supply problem.

A shortage of natural rubber at least 2 more years is foreseen. Until more natural rubber is available, the report is said to recommend that the government-owned "general purpose" (G.R.-S. butadiene-styrene) plant should not be disposed of as surplus. While a later statement is expected to recommend definite action, the present report is specific enough to allow Reconstruction Finance Corp. to declare some of the synthetic plants surplus and proceed with their sale.

Under the report, the Government would make possible continued operation of the synthetic-rubber plants deemed essential. Price competition from natural rubber would be met through tariff adjustment, subsidies, and other incentives. As a further measure of security, it is recommended that a natural-rubber stockpile be maintained in sufficient quantity to guard manufacture in the event of another emergency shutoff of imports.

New Laboratory Planned

MIDLAND, Tex.—Standard Oil Co. of Texas' laboratory here is being enlarged with an addition which will house an insoluble residue laboratory. Dr. H. A. Ireland, formerly with the United States Geological Survey, will be in charge.

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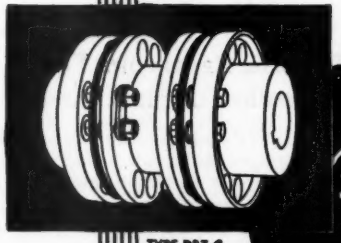

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PIPE LINES

Panhandle Eastern Reports Strengthening of Reserves

NEW YORK. — Panhandle Eastern Pipe Line Co. now holds gas purchase contracts and either full or 50 per cent working interests in 634,085 acres of producing land against 564,-115 acres at the end of 1944, according to a company report to stockholders.

At the end of 1945, the company also owned mineral leases on 111,170 acres adjacent to the known proven area of the Hugoton and Panhandle fields, of which a substantial portion is expected to yield gas in paying quantities. To further strengthen its reserve position, the management has leased another 190,537 acres of favorable land in Oklahoma, Kansas, Colorado, and Michigan.

Panhandle Eastern expects to complete soon its $10,500,000 expansion program begun last year to supply gas to distributing companies in the Appalachian region.

Airports, Reservoirs Force Relocation of Shell Lines

HOUSTON.—Shell Pipe Line Corp. engineers consider as positively uncanny the way in which their original lines were laid across what seems to have been every potential airport and reservoir site in the country.

Already five of the pipe lines have been relocated, and about twice that many relocating jobs are in prospect with the postwar resumption of large-scale construction. Latest is the new Barker reservoir some 20 miles west of Houston. Here an earthen dam is being built to protect Houston's industrial district from occasional floods.

Through the middle of the area ran Shell's 10-in. pipe line. Army engineers who designed the $30,000,000 project and Shell management agreed to reroute both the line and the parallel telephone system.

Elsewhere Shell has found similar projects atop its lines. The Oklahoma City, Lucien, and Oxford lateral lines were relocated on account of construction of the Oklahoma City, Stillwater, and Struthers airports. Extensive relocation of the dual Cushing-Wood River lines was required by construction of the Grand River reservoir, and the Kilgore-Houston line was changed in grade with the building of the San Jacinto Ordnance Depot.

Another relocation of the Cushing-Wood River line is expected at the enlarged Lambert-St. Louis airport as well as at the projected St. Louis "Columbia Bottoms" airport. Plans for enlarging the Houston airport will require changes in the McCamey-Houston line. On top of this are the Oolagah and Mannford reservoirs on the Cimarron River, the Chain of Rocks diversion canal east of the Mississippi River, the Rockland reservoir across the San Jacinto and Angelina rivers, and the San Jacinto River reservoir all of which affect Shell pipe lines.

FPC Approval Sought for $1,500,000 Kentucky Line

WASHINGTON. — Approval of a plan to build an additional pipe line in Kentucky at an estimated cost of $1,500,000 is asked of the Federal Power Commission by Cincinnati Gas Transportation Co., an affiliate of Columbia Gas & Electric Corp.

The proposed line, to be completed by November 1, would be a 14-in. carrier extending 70 miles from the company's 20-in. line near Foster, Ky., to an interconnection with the 24-in. line of Tennessee Gas & Transmission Co. near Means, Ky. The application states the line will give Cincinnati Gas Transportation an additional 50,000,000 cu. ft. daily from Tennessee Gas & Transmission for delivery to Cincinnati Gas & Electric Co. and Union Light, Heat & Power Co.

Majewski Assails Plan Of SPA for Inch Lines

CHICAGO.—The Surplus Property Administration's recommendations on disposal of the Big Inch pipe lines have come under further attack in a letter by B. L. Majewski, vice president of Deep Rock Oil Corp., to Sen. Joseph C. O'Mahoney.

Asserting that the problem of tankers and the pipe lines are inseparable, Majewski told the senator that the government could possibly realize $143,500,000 from 50 tankers and from the pipe lines sold for use in transporting natural gas. To sell the lines as petroleum carriers, less cost of additional feeder facilities to West Texas, the government would get $100,000,000 and still own the tankers

"for which there would be practically no alternative use.".

The Deep Rock executive said he assumed full value in illustrating the economics of the two types of sale. "Exactly the same principle applies if these facilities are sold at 80 per cent or 60 per cent of their valuation," he added.

In his letter to the chairman of the special committee investigating petroleum resources, Majewski took pointed exception to many statements made in the SPA report. "It is difficult to explain inconsistencies and falsification of data included in the report," he said. "It contains specious arguments, false figures and illogical conclusions."

The SPA report, he said, only speculates on the question of whether sufficient oil is available to fill the lines, while most competent observers do not believe there is. "There is no question about the availability of gas to fill the lines, as evidenced by the testimony before your committee as well as statements in the Ford, Bacon, and Davis report."

"It would be difficult to conceive of a more effective plan," Majewski said, "to practically insure the elimination of the independent refinery in the Mississippi and Ohio river valleys" than the proposal suggested by the SPA that the eastern portion of the Little Inch line be reversed and finished products shipped by east coast plants westward. "An additional 380,000 bbl. of refined products dumped into the Ohio and Mississippi valleys and Great Lakes territories would inundate this whole area."

Hearing Set for March 8 On West Texas Gas Application

WASHINGTON. — A hearing has been set for March 8 in Washington by the Federal Power Commission on a request of the West Texas Gas Co. for authority to operate facilities constructed under a temporary permit.

The facilities, consisting mainly of 11 miles of 10¾-in. loop line in Hale County, Texas, and an additional 400-hp. capacity compressor unit at the company's McSpadden station in Randall County, Texas, are needed to meet the estimated peak firm demand of 50,800,000 cu. ft. daily during the 1945-46 heating season, according to the application. Over-all cost of the facilities is $160,466.

N.P.A.'s New Crude Rate Digest Now Being Mailed

WASHINGTON. — Information on all tariffs filed with the Interstate Commerce Commission is contained in the 1946 Digest of Crude Petroleum Line Rates which is being distributed by the National Petroleum Association.

Harry S. Elkins, traffic attorney for the association and editor, said the publication contains all data filed prior to January 15 and that a subsequent digest of gasoline and other products will give information on these tariffs up to February 15. To keep the edition current, subscribers will be furnished inserts as new rates and rules become effective.

Bomb Shell Cases Converted For New Kansas Pipe Line

WICHITA. — War surplus casing originally intended for use in making bomb shell cases is to be used in Socony-Vacuum Oil Co.'s 32-mile pipe line from the Morrel pool of Graham County in northwestern Kansas to the Bemis station on the Kaw Pipe Line Co. trunk.

The 8-in. casing was acquired from the U. S. Surplus Property office and consists of 32-ft. lengths. Socony-Vacuum's White Eagle division has let a contract to Rumsey Brothers of Wichita to string and lay the pipe line.

The Kansas Corporation Commission was to resume a hearing this week on the application for construction of the line. Protesting the proposal are Merrimac Oil Co., and the Farmers Cooperative Oil Co.

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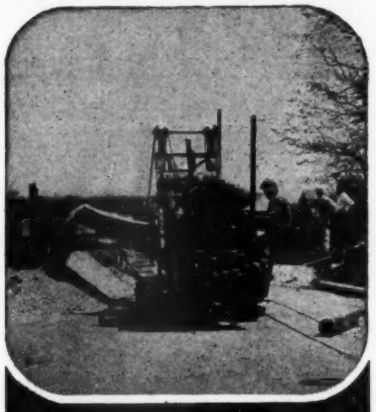

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PIPE LINE SUPPLIES AND EQUIPMENT

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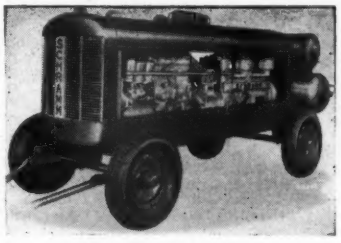

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STATISTICS and

WEEKLY WELL COMPLETIONS . . . WEEK ENDED FEBRUARY 23, 1946

	Total of all wells					Cum. to date		Wildcat completions and discoveries					Cumulative total, 1946				
	Comp.	Oil	Gas	Dry	Footage	1946	1945	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	32	16	0	*16	54,690	229	201	0	0	0	0	0	0	0	0	0	0
Pennsylvania	73	38	2	†33	121,176	665	429	0	0	0	0	0	0	0	0	0	0
West Virginia	12	1	10	1	40,154	88	77	0	0	0	0	0	0	0	0	0	0
Ohio	19	4	10	5	52,802	156	111	0	0	1	1	2	1	0	5	6	12
Indiana	6	5	0	1	13,450	44	32	0	0	0	0	0	0	0	0	5	5
Kentucky	7	3	2	2	14,397	64	62	0	0	0	1	1	1	0	0	9	10
Illinois	34	23	0	11	88,257	288	271	0	0	0	5	5	4	0	0	54	58
Michigan	12	5	2	5	32,222	100	107	0	0	0	3	3	1	0	0	34	35
Kansas	31	21	4	6	99,985	324	210	2	0	0	3	5	4	0	1	42	47
Neb., Mo., Iowa	2	2	0	0	4,511	3	8	0	0	0	0	0	0	0	0	1	1
Oklahoma	58	34	14	‡10	198,198	372	356	1	0	3	4	8	10	0	7	52	69
Texas	143	98	11	34	660,118	1,152	1,044	2	1	0	15	18	19	1	5	170	195
North Central	40	25	0	15	113,887	386	302	0	0	0	3	3	5	0	0	56	61
West	38	34	0	4	195,535	251	279	1	0	0	4	5	7	0	0	26	33
Panhandle	9	3	6	0	26,490	59	86	0	0	0	0	0	0	0	0	2	2
Eastern	11	5	3	3	69,792	106	42	0	0	0	2	2	1	0	1	21	23
Gulf Coast	28	21	1	6	184,267	276	242	1	0	0	1	2	4	0	2	43	49
Southwest	17	10	1	6	70,147	74	93	0	1	0	5	6	2	1	2	22	27
Louisiana	24	15	1	8	176,737	176	136	2	0	0	1	3	12	1	0	18	31
Northern	10	4	0	6	43,101	89	42	0	0	0	1	1	2	0	0	13	15
Southern	14	11	1	2	133,636	87	94	2	0	0	0	2	10	1	0	5	16
Arkansas	5	2	0	3	20,186	26	25	1	0	0	2	3	2	0	0	4	6
Mississippi	3	2	0	1	24,022	33	44	0	0	0	1	1	0	0	0	8	8
Southeastern States	0	0	0	0	0	8	3	0	0	0	0	0	0	0	0	7	7
Montana	7	3	0	4	14,499	39	45	0	0	0	1	1	0	0	0	2	2
Wyoming	6	5	0	1	24,093	29	32	1	0	0	1	2	2	0	2	11	15
Colorado	1	1	0	0	6,378	16	6	0	0	0	0	0	0	0	0	3	3
New Mexico	8	5	3	0	26,073	64	73	0	0	0	0	0	1	0	0	6	7
California	24	18	0	6	102,528	270	347	1	0	0	5	6	3	0	1	32	36
Total United States	507	301	59	147	1,774,476	4,146	3,678	10	1	4	43	58	60	2	21	464	547
Total previous week	472	262	46	164	1,650,467	3,640	3,218	10	0	3	55	68	51	1	17	421	490
Total Feb. 24, 1945	460	230	44	186	1,639,008	3,678	2,833	11	0	1	73	85	84	1	23	516	624

Service wells included: *16, †29, ‡1.

MARKET QUOTATIONS

(This market data given below is abbreviated. Quotations on other products than those shown here furnished on request. Quotations are f.o.b. plant in tank cars and in cents per gal. as of last Monday.)

REFINERY GASOLINE

Octane (A.S.T.M.)	78-80†	73-75
Mid-Continent*	6.00-6.25	5.25-5.75
Texas Gulf Coast	6.375	5.375-5.75
New York Area		7.425-7.90
California		6.50-7.00

*Basic Oklahoma Group 3. †1939 C.F.R. (research method).

NATURAL GASOLINE

Grades:	26-70	18-55
Oklahoma (Group 3)	2.750	3.300
N. Texas (f.o.b. plant)	2.250	2.700
N. Louisiana (f.o.b. plant)	2.625	3.150
California	4.875	5.500

CRUDE-OIL PRICES

Representative posted schedules per bbl.	
East Texas	$1.25
Conroe	1.43
Tepetate, Louisiana, avg. grav.	1.20
Illinois Basin	1.37
Pecos County, Texas	.95
Bradford, Pennsylvania	3.00
Van, Van Zandt County, Texas	1.09

Note: Exclusive of subsidy.

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Texas	West Tex.*
18-18.9	$0.80	....	....	....
19-19.9	.84	....	$1.06	$0.70
20-20.9	.88	$0.85	1.08	.72
21-21.9	.92	.87	1.10	.74
22-22.9	.96	.89	1.12	.76
23-23.9	1.00	.91	1.14	.78
24-24.9	1.03	.93	1.16	.80
25-25.9	1.07	.95	1.18	.82
26-26.9	1.11	.97	1.20	.84
27-27.9	1.15	.99	1.22	.86
28-28.9	1.18	1.01	1.24	.88
29-29.9	1.20	1.03	1.26	.90
30-30.9	1.23	1.05	1.28	.92
31-31.9	....	1.07	1.30	.94
32-32.9	....	1.09	1.32	.96
33-33.9	....	1.11	1.34	.98
34-34.9	....	1.13	1.36	1.00
35-35.9	....	1.15	1.38	1.02
36-36.9	....	1.17	1.40	1.04
37-37.9	....	1.19	1.42	1.06
38-38.9	....	1.21	1.44	1.08
39-39.9	....	1.23	1.46	1.10
40 and above	....	1.25	1.48	1.12

*Includes Lea County, New Mexico.

A.P.I. REFINERY REPORT

Week ended February 16, 1946
(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks—Gasoline	Stocks—Distillate	Stocks—Residual
East Coast	784	22,645	8,116	6,591
Appalachian	155	4,259	561	590
Ill., Ind., Ky.	707	22,988	3,453	3,087
Okla., Kan., Mo.	385	9,978	1,321	1,022
Inland Texas	207	3,140	275	666
Tex. Gulf Cst.	1,182	17,082	4,782	4,130
La. Gulf Cst.	305	5,347	1,565	1,248
N. La., Ark.	55	1,723	494	217
Rocky Mtn.	115	2,246	388	698
California	750	15,825	6,318	21,787
Total 2-16-46	4,643	105,233	27,273	40,036
Total 2- 9-46	4,512	103,952	28,301	39,555
Total 2-17-45	4,835	95,373	28,787	48,150

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended:	Bbl. of crude*
February 9, 1946	223,303,000
February 2, 1946	224,351,000
February 17, 1945	220,060,000

*Excludes unrefinable Calif. stocks.

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

	Feb. 23 crude oil	Bureau of Mines demand forecast	Feb. 16 crude oil
Alabama	1,050	500	1,000
Arkansas	77,500	74,000	77,500
California	845,100	844,000	842,300
Colorado	23,480	24,000	22,620
Eastern	63,800	61,200	61,250
Florida	100	100	100
Illinois	211,700	198,000	207,150
Indiana	17,050	13,000	16,200
Kansas	253,650	254,000	259,650
Kentucky	30,400	29,000	30,050
Louisiana	370,800	368,000	367,900
North Louisiana	82,000	.....	79,200
South Louisiana	288,800	.....	288,700
Michigan	45,290	46,000	42,100
Mississippi	52,850	49,000	55,100
Montana	21,650	20,400	21,640
Nebraska	850	800	750
New Mexico	98,300	96,000	98,250
Oklahoma	390,050	368,000	389,450
Texas	2,109,800	1,890,000	2,110,000
East Texas	321,300	.....	321,300
East Central Texas	146,100	.....	146,150
North Central Texas	157,700	.....	157,650
Texas Panhandle	81,000	.....	81,100
West Texas	503,400	.....	503,400
Southwest Texas	356,200	.....	356,300
Texas Gulf Coast	544,100	.....	544,100
Wyoming	91,100	94,000	91,330
Total United States	4,704,520	4,430,000	4,694,340

Change from previous week up 10,180

Total production January 1-February 23 ..... 258,446,300 bbl.

Same period last year ..... 255,460,050 bbl.

CRUDE-OIL STOCKS 223,303,000 bbl. as of Feb. 9—down 1,048,000 bbl. One year ago 220,060,000 bbl.

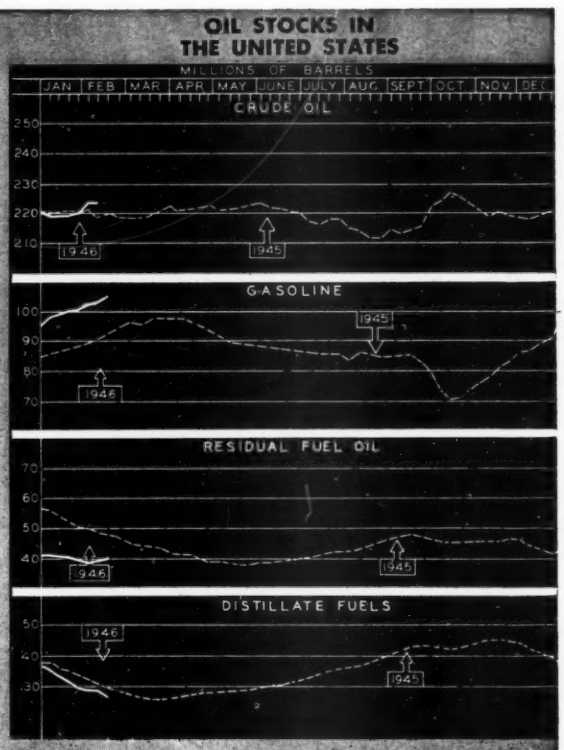
GASOLINE STOCKS 105,233,000 bbl. as of Feb. 16—up 1,281,000 bbl. One year ago 95,373,000 bbl.

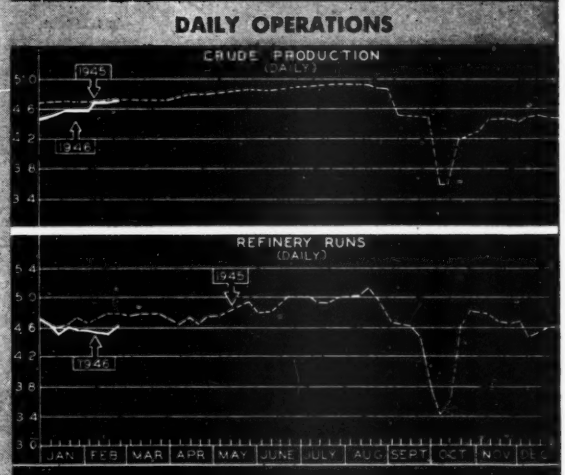
RESIDUAL FUEL-OIL STOCKS 40,036,000 bbl. as of Feb. 16—up 481,000 bbl. One year ago 48,150,000 bbl.

GAS OIL AND DISTILLATE STOCKS 27,273,000 bbl. as of Feb. 16—down 1,028,000 bbl. One year ago 28,787,000 bbl.

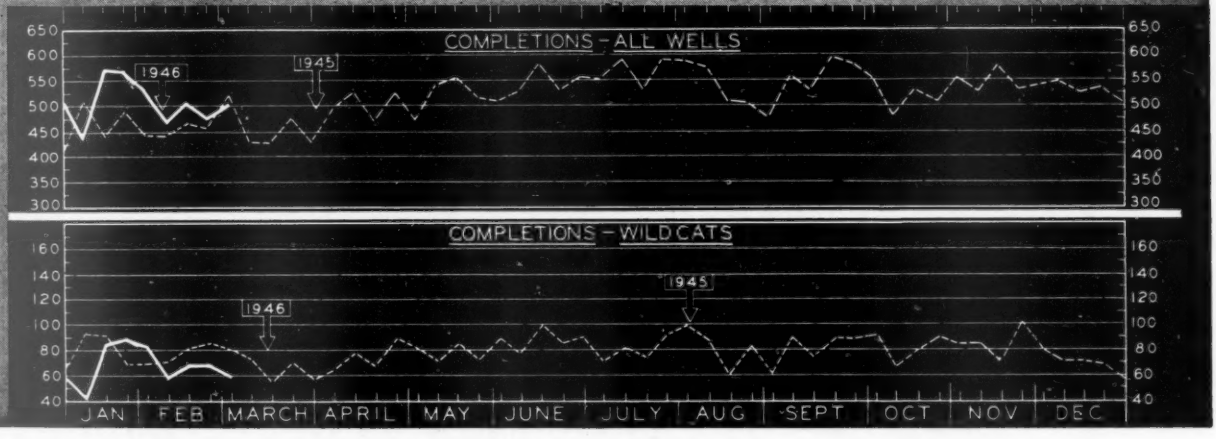
CRUDE-OIL PRODUCTION 4,704,520 bbl. as of Feb. 23—up 10,180 bbl. One year ago 4,777,250 bbl.

REFINERY RUNS 4,643,000 bbl. daily week ended Feb. 16—up 131,000 bbl. One year ago 4,835,000 bbl.





Solid line charts weekly completions, service wells in Eastern area included



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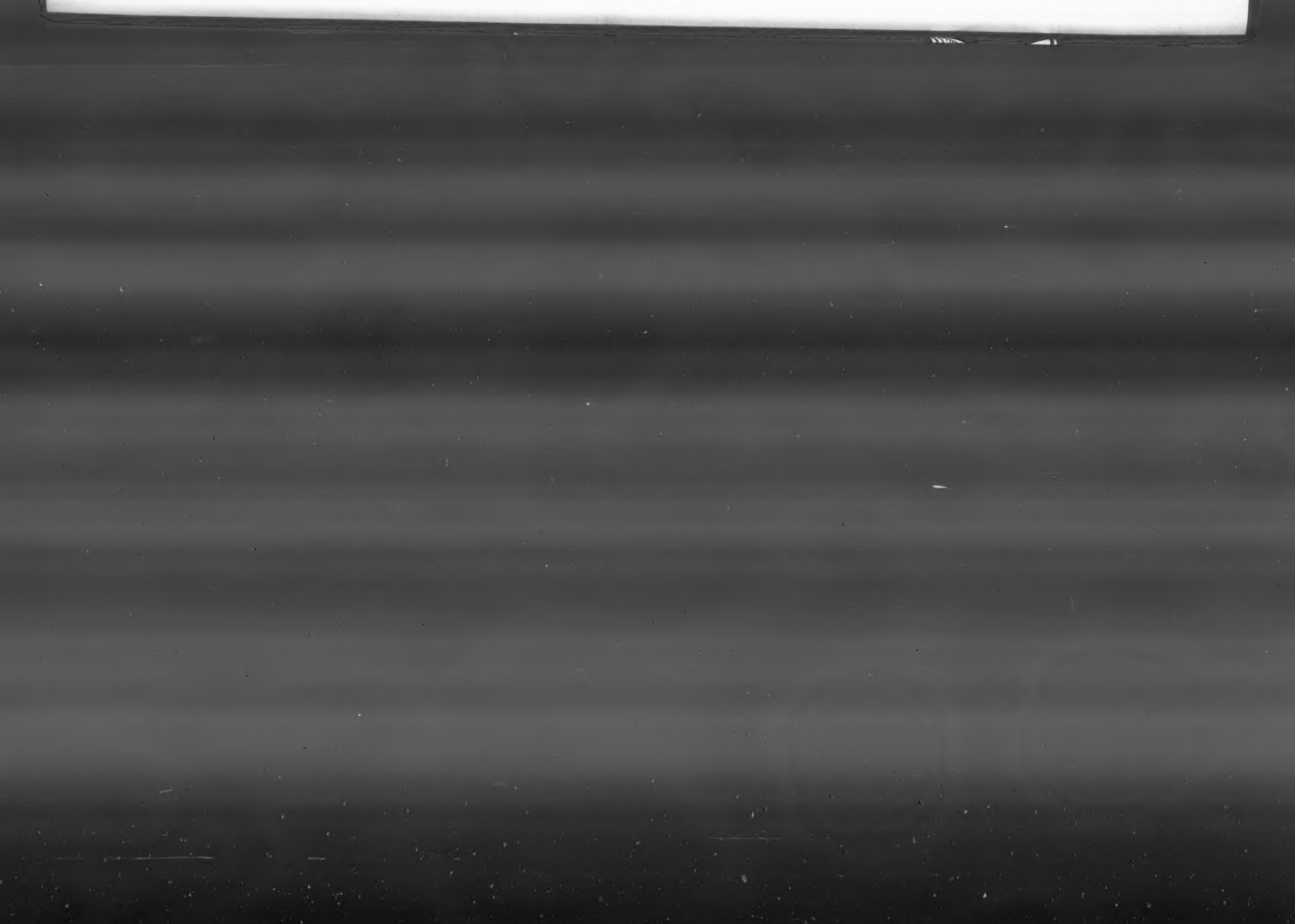

Exploration and Drilling

Florida Test Cores Saturation

EIGHT feet of saturated lime have been found in cores between 10,180 and 10,250 ft. in the wildcat being drilled by the M. L. Benedum interests on Barnes Sound, about 25 miles due south of Miami, Florida, according to official information.

The well, O. D. Robinson 1 State (Blanchard Concession) is located approximately in N/2 N/2 NW 29-59s-40e, near the southeast corner of Florida, in Dade County. The actual location is off-shore, in Barnes Sound, between the mainland and Key Largo. It is in the northeast corner of the Blanchard Concession, which originally comprised some 7 million acres of state lands, at, on, and off the southern tip of the Florida Peninsula; on a portion which was transferred to the M. L. Benedum interests.

While drilling in a fairly dense dolomitic lime at 10,165-75 ft., making about 3½ ft. of hole per hour, the cuttings showed signs of oil. Coring was started at 10,175 ft., continued to present total depth of 10,258 ft., and is still going ahead. A string of 7-in. casing is unofficially reported to be enroute from Texas, for a production test. At present the well has 80 ft. of 24-in. surface pipe; 522 ft. of 20-in., and 3,580 ft. of 13⅜-in. casing in the hole.

The oil showing in the saturated core is black, and from appearances, if commercial production should be developed, it seems likely to be similar to that being produced in the Humble Oil & Refining Co. wells at Sunniland, in Collier County, or about 20° gravity. The Sunniland wells are about 66 miles north and 60 miles west of the present test.

Earlier unofficial reports on the Barnes Sound test gave the top of the Lower Cretaceous, based on samples, at 7,020 ft. The nearest dry holes on which data are available are the Peninsula Oil & Refining Co. 1 Cory, 6-55s-34e, in the northeast corner of Monroe County, total depth 10,006 ft., and the Florida East Coast Railroad Co. well at Marathon, Key Vaca, total depth 2,310 ft. The latter well, (See Florida Geological Survey W-2), as the name implies, is one one of the keys, south of the mainland, south and west of the north-south Monroe-Dade County boundary line.

The Applins (See A.A.P.G. Bulletin, December 1944) give the top of the Lower Cretaceous in the Peninsula well as 8,168 ft. The Key Vaca test stopped in the Oldsmar limestone of Eocene age. A hypothetical projection might put the top of the Lower Cretaceous in the Key Vaca test at round 8,000-8,100 ft.

TEXAS GULF COAST

Completion Under Way at Chambers County Wildcat

HOUSTON.—In Chambers County, 6,500 ft. southeast of Mayes field production, Humble Oil & Refining Co. is making a second attempt to complete 1 Lula Wallis et al in the Samuel Mather Survey, Abstract 192, Block 13. The well is flowing clean condensate with 8,400 cu. ft. of gas hourly through a ¼-in. choke with 350 lb. flowing pressure on the tubing. Flow is from open hole below the 5½-in. between 9,995-10,010 ft. Initial test made from open hole at 9,995-10,000 ft. flowed 27 bbl. of 53°-gravity condensate in 11½ hours through a ¼-in. choke with a gas-oil ratio of 12,900 to 1 and 600-lb. flowing pressure. Hole was then cored 10 ft. deeper for the current test. Humble is moving in materials and building roads to drill 1 Franklin which is 2,000 ft. northwest of this test.

The Ohio Oil Co. 1 Kirby Lumber Corp., wildcat discovery well 6 miles east of Cleveland in Liberty County, James McCoy League, is now waiting on equipment before continuing the production test. Pipe was perforated with 63 shots from 9,106-27 ft., and the well was almost cleaned when lines froze up. Tubing pressure was 3,200 lb. and casing pressure was 3,300 lb. when the well was shut in. This well was drilled and cored to a total depth of 10,285 ft. and finding nothing of further interest below the 9,100-ft. stratum, the well was plugged back with a 7-in. pipe setting at 9,209 ft. Ohio has derrick up, and pits are being dug to drill its 2-A B. E. Quinn, 1 mile northeast of 1 Kirby discovery. This test is scheduled to go to 10,300 ft.

An extension test 5,750 ft. northeast of discovery well for Columbus field of Colorado County, Texas Gulf Producing Co. 1 Earline Landig, is at total depth of 8,864 ft. where electrical log is being run, after which production pipe will be run. Pipe will be set close to bottom for a test of all the sands. First sand showing oil was topped at 7,312 ft., the next being 7,875 ft. where a drill-stem test recovered 1,380 ft. of oil and 180 ft. of salt water.

One-third mile southeast extension at Old Ocean field in Brazoria County, Magnolia Petroleum Co. and J. S. Abercrombie 1 H. B. Vezey et al Unit, has been completed for a gage of 295 bbl. of 47°-gravity oil daily through a 16/64-in. choke with 3,550-lb. pressure on the tubing. Pay was topped at 10,820 ft. Total depth is 11,010 ft. with 7-in. casing on bottom, and perforations from 10,960-980 ft. for completion.

Sun Oil Co. 15 Broussard & Hebert, wildcat test 8,200 ft. northeast of nearest production in the LaBelle field of Jefferson County, in A. Hotchkiss League, Abstract 13, is dry at 9,891 ft. Hole was plugged back and a test made in the 8,000-100-ft. level before completion.

There were 16 new locations reported this week, 3 being wildcats, 1 each in Chambers, Fayette, and Jackson counties. Of the nine completions, only one was a dry wildcat in Jefferson County.

UPPER GULF COAST WILDCAT FAILURE

Jefferson County: Sun Oil Co. 15 Broussard & Hebert, A. Hotchkiss League, Abst. 31, in LaBelle area, dry at 9,891 ft.

EASTERN TEXAS

Leon County Test Produces Oil From Woodbine Sand

DALLAS.—Claude Bell 1 Brown-Carson, Thomas H. Garner Survey, wildcat 3 miles southeast of Flynn, Leon County, pumped 34 bbl. 39°-gravity oil in 21 hours. Operator is pumping and testing. Elevation is 415 ft. and total depth is 7,303 ft. Woodbine was topped at 7,100 ft. Tex-Harvey Oil Co. 1 Reitsch, O. Weir Survey, Abstract 920, wildcat 6 miles south of the Lone Star field, Cherokee County, topped the Woodbine at 4,325 ft. Casing will be run and the Woodbine, which showed a little oil and gas in cores, will be tested.

Delta Drilling Co. 1 Rayford, James Smith Survey, Abstract 709, wildcat 1½ miles south of Henderson, Rusk County, set 5½-in. casing to test the Travis Peak for possible gas-distillate production. With elevation of 390 ft., Travis Peak was entered at 7,306 ft. Total depth is 7,519 ft. Humble Oil & Refining Co. 1 Pickering Lumber Co., Francois Survey, Abstract 207, wildcat in the Huxley sector of eastern Shelby County, resqueezed from 7,185-7,322 ft. after 6½-hour drill-stem test recovered 4,000 ft. of gas-cut mud with little gas blow. Magnolia Petroleum Co. 1 Orr, Fowler Survey, northwestern Marion County wildcat southwest of Avinger, was drilling below 9,588 ft.

Hawkins field, Wood County, reported three completions this week and Carthage field, Panola County, two. Opelika field, Henderson County, Calvert field, Milam County, Pickton field, Hopkins County, and Talco field, Franklin County, each had one. Hawkins field had five locations, Carthage field, Talco field, and East Long Lake field, Anderson County, had one each. Hawkins field has 30 drilling wells; Carthage field 24; Pickton field, Hopkins County, 6, and New Hope field, Franklin County 5.

EASTERN TEXAS WILDCAT FAILURES

Hopkins County: Delta Drlg. 1 Livingston, Nacogdoches University Land Sur., 3 mi. SE Reilly Springs, elev. 460 ft., Glenrose 6,574 ft., Travis Peak 8,426 ft., dry at 8,632 ft.

Rains County: Sohio 1 Mrs. Della Butler,

E. Gideon Sur., 7 mi. NE Emory, elev. 392 ft., Paluxy 6,137 ft., Massive Anhydrite 7,526 ft., dry at 8,500 ft.

PERMIAN BASIN

Andrews County Wildcat Fails to Make Producer

MIDLAND.—Stanolind Oil & Gas Co. 1 Williamson, Section 5, Block 45, T-1-N, T&P Survey, wildcat 15 miles northwest of the Goldsmith pool of northwestern Ector County, is dry at 10,300 ft. after a 1-hour drill-stem test from 10,182-290 ft. recovered 606 ft. of mud and 6,110 ft. of salty sulfur water. Phillips Petroleum Co. 1 Eidson, Section 25, Block B-15, Public School Land Survey, ¾ mile west of the north end of the Penwell pool, Ector County, ran a drill-stem test on the upper part of the Devonian from 7,083-7,130 ft. and recovered 15 ft. of mud when tool was pulled after being open 25 minutes. Operator will deepen. Stanolind 1 Eva B. Kayser, Section 34, Block 43, T-2-S, T&P Survey, wildcat 5 miles southwest of Odessa, Ector County, was drilling below 10,318 ft. in lime and shale.

Sid W. Richardson 1 S. T. Dawson, Section 2, A. L. Brigance Survey, wildcat in eastern Crane County, took a 45-minute drill-stem test of the Ellenburger from 7,232-82 ft. and recovered 780 ft. of drilling mud. Anchor on the testing tool was lost and operator was preparing to retest. Stanolind 1 Mike Veretto, Labor 7, League 72, Val Verde County School Land Survey, wildcat 2 miles west of Levelland and southeast of the Levelland pool, Hockley County, was shut in 12 hours then flowed 37 bbl. of oil and 1 bbl. of basic sediment and water in 1½ hours through 2-in. tubing. The well went dead at the end of the period. Operator was preparing to inject more acid. Total depth is 4,889 ft.

R. A. Gillespie & Sons 1 B. N. Wilke, Section 1, Day Land & Cattle Survey, wildcat 4½ miles northeast of Ballinger, Runnels County, took a drill-stem test from 2,460-90 ft. in Gunsight lime. Recovery was 15 ft. of oil-cut mud and 4 ft. of clean oil. Kerr-McGee Oil Industries, Inc., 1 J. A. Fetter, Section 17, Block CB, C&MRR Survey, wildcat southwest of the town of Wolforth, Lubbock County, is dry at 6,889 ft. in lime and chert. Humble Oil & Refining Co. 1 Pio Crespi, Section 19, Block 38, T-2-S, T&P Survey, 1 mile northwest of the discovery in the Midland pool of Midland County, 9 miles southeast of Midland, cemented 7-in. casing on bottom at 9,900 ft. Pay in the discovery was topped at 10,330 ft.

Sharon Ridge field, Scurry County, reported five completions this week, Keystone-Ellenburger field, Winkler County, and TXL field, Ector County, three each and Fullerton field, Andrews County, and Mabee field, Martin County, two each. Garza field, Garza County, had five locations. Sharon Ridge field and Fullerton field each had two. TXL field has 36 drilling wells, Keystone-Ellenburger field has 35, Block 31 field, Crane County, has 22, Fullerton field 25 and Welch field, Dawson County, 10.

WEST TEXAS SUCCESSFUL WILDCAT

Ector County: Extension to old oil pool—Texas 1-D Fraser, Sec. 27, Blk. 45, T-1-S, T&P Sur., east extension to TXL-Ellenburger pool, elev. 3,263 ft., flowed 1,700 bbl. day through ½-in. choke on 2-in. tubing natural, perf. 10,790-890 ft. Ellenburger, gravity 41.9°, gas-oil ratio 531 to 1, TD 10,975 ft.

WEST TEXAS WILDCAT FAILURES

Andrews County: Magnolia 2 Martin, Sec. 12, Blk. A-47, PSL, 13 mi. W Andrews, elev. 3,290 ft., Mississippian 8,760 ft., Devonian 9,245 ft., dry at 10,414 ft.

Crane County: Gulf 1-E Cordova Union, Sec. 7, Blk. 35, H&TC Sur., NW edge McCamey pool, elev. 2,468 ft., Fusselman 5,440 ft., Simpson 5,665 ft., dry at 6,929 ft.

Pecos County: Geo. T. Abell 1 Blackman & Scharff, Sec. 22, Blk. 3, H&TC Sur., 3 mi. NE Pecos Valley pool, elev. 2,411 ft., dry at 1,995 ft.

Upton County: Gulf 1-E J. D. Starnes, Sec. 1, Julia A. Prater Sur. A-351, 9½ mi. NW McCamey, elev. 2,566 ft., Silurian 7,770 ft., Montoya 7,885 ft., dry at 7,933 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—Dekalb Agricultural Association 2 White, 20-10s-28e, wildcat 25 miles east and slightly north of Roswell, Chaves County, is dry at 3,505 ft. in middle Permian. Continental Oil Co. 1 Mullis, 21-15s-29e, wildcat 20 miles northeast of Artesia, Chaves County, was drilling below 5,501 ft. in lime.

Grayburg Oil Co. 10-A Keeley, 24-17s-29e, 6,500-ft. test in the Grayburg-Jackson pool, Eddy County, was drilling below 3,207 ft. in lime. It logged slight oil shows from 2,660-2,700 ft., from 2,839-61 ft., from 2,913-39 ft., and from 3,052-75 ft.

Russell field, Eddy County, West Roberts, Drinkard and Paddock fields, Lea County, each reported one completion this week. Empire field, Eddy County, had two locations, Square Lake field, Eddy County, and Langlie-Mattix field, Lea County, each had one. Eddy County has 27 drilling wells with 8 wildcats and Lea County has 37 with 8 wildcats.

SOUTH LOUISIANA

Tests of LaFourche Parish Wildcat Show Salt Water

NEW ORLEANS.—In the Little Temple area of LaFourche Parish, Humble Oil & Refining Co. 1 Louisiana Delta Co., wildcat test, 19-17s-23e, is running tubing for a third attempt to establish production and open a new field in the South Louisiana district. Pipe has been perforated with 32 shots from 10,587-91 ft. for the try. Total depth of the hole is 12,007 ft. and 5½-in. pipe is cemented to 10,735 ft. Two previous tests made through perforations at 10,631-36 ft. and 10,609-615 ft. have shown salt water and gas.

Latest gage on Humble 1-B Mrs. J. A. Bel Estate, Oberlin area discovery, Allen Parish, 33-5s-4w, is 131 bbl. of pipe-line oil daily through a 5/32-in. choke with 1,050-lb. flowing pressure on the tubing. However, gas-oil ratio is still increasing and is now 3,221 to 1. Gravity of oil is 47° corrected, and well has a shut-in pressure of 5,500 lb. Production is through 36 perforations at 10,658-10,662 ft. Tubing is set at 12,658 ft.

Barnsdall Oil Co. has been unable to bring the new deep sand into satisfactory production at West Tepetate, in Jefferson Davis Parish. The 1 M. M. Stafford Unit, 36-7s-3w, tested gas with some 52°-gravity condensate through 24 perforations in the new deep sand from 9,894-9,902 ft., and showed 6,300-lb. pressure while flowing through the tubing. Another deep test was made through perforations at 9,512-22 ft. and 9,522-28 ft. which showed gas and 2,900 lb. shut-in pressure, but bled down to 100 lb. when opened, flowing only a small amount of oil. Hole was plugged back and the well is now completed in the field's deepest sand through perforations at 9,328-36 ft. The well is still testing through various-sized chokes, latest gage being 50 bbl. of 52° gravity condensate through a 9/64-in. choke with a gas-oil ratio of 28,565 to 1, and 4,800-lb. tubing pressure. Barnsdall also completed 10 Minos D. Miller at West Tepetate 31-7s-2w. It flowed 260 bbl. of 36°-gravity oil daily through a 10/64-in. choke with 1,300-lb. tubing pressure, and gas-oil ratio 538 to 1. Production is through 60 perforations at 8,496-8,506 ft.

Humble 1 Baist Cooperage Lumber Co., Inc., wildcat blowout in the Bayou Sorrell area of Iberville Parish, 93-12s-13e, is to be plugged, and operators are now trying to set cement. The well blew out for 5 hours, and caught fire, however, the well bridged and choked off the flow.

There were seven new locations reported this week, no wildcats. There were two wildcats included in the 14 completions reported, 1 a new pool opener in Allen Parish, and 1 a new pay in Egan field, Acadia Parish. Acadia Parish led with three completions this week. Plaquemines, St. Martin, and Vermilion parishes received two completions each.

SOUTH LOUISIANA SUCCESSFUL WILDCATS

Acadia Parish: New oil pay Egan field—Sun Oil Co.-Sohio Oil Co. 1-A Hayes, 38-9s-1w, oil 9,897-9,908 ft., TD 10,649 ft., perf. 44 holes 9,897-908 ft., PT 175 bbl. 24 hours through 12/64-in. choke, tubing pressure 3,250 lb., gravity 47°, no water, gas-oil ratio 640 to 1.

Allen Parish: Oberlin area discovery—Humble Oil & Refg. Co. 1-B Mrs. J. A. Bel Estate, Center NW NE 33-5s-4w, top sand 12,650-669 ft. Wilcox, perf. 30 holes 12,658-62 ft., TD 13,150 ft., PT 74 bbl. daily on 9/64-in. choke, and 2,688,000 cu. ft. gas, gas-oil ratio 5,584 to 1, tubing pressure 630 lb., 47° gravity, no water.

N. CENTRAL TEXAS

Sivells Bend Test Swabs Oil From Ellenburger

WICHITA FALLS.—Standard Oil Co. of Texas 2 Beasley, M. McKerley Survey, deep test in the Sivells Bend field of Cooke County, topped the Ellenburger at 8,640 ft. It swabbed clean oil from 7,200-8,000 ft., and tested about 2 bbl. of oil and an unestimated amount of water in 8 hours through perforations from 8,900-50 ft. Total depth is 9,155 ft. Testing will continue. Standard of Texas 3 Beasley, test in the same area, has been completed to flow 18.63 bbl. in 3 hours through perforations from 6,672-92 ft. Gas-oil ratio is 626 to 1.

Denver Producing & Refining Co. 1 Jewell, Block 15, William Allen Survey, wildcat 6 miles southeast of Gordonville, northern Grayson County, having topped the Ellenburger at 8,818 ft., was drilling below 8,950 ft. in hard lime. The wildcat attracted considerable attention when it encountered 77 feet of oil-saturated Simpson sand, topped at 8,468 ft. Standard of Texas 1 Mitchell, proposed 10,500-ft. wildcat, 1½ miles northwest of Sherman in Grayson County, is drilling below 5,827 ft. in shale. This is a "tight" well.

S. D. Johnson 1 Willis, S. Cary Survey, wildcat 2½ miles north of Forrestburg, Montague County, drilled heavily saturated porous lime from 7,301-29 ft. A 1-minute drill-stem test recovered 630 ft. of gas-cut drilling mud. A 75-minute drill-stem test from 7,354-7,404 ft. recovered 3,200 ft. of salt water. Marble Falls was topped at 7,210 ft.

Electra field, Wichita County, reported five completions this week, Thomas field, Archer County, four, and Holliday field, Archer County, Gatewood and Sivells Bend fields, Cooke County, and KMA field, Wichita County, each had three. Wichita County had 17 new field locations, Archer County 11, and Cooke and Young counties each had 7. Sivells Bend field has nine drilling wells, Hildreth field, Montague County, has seven; Cooper field, Archer County, Nocona and Bowers fields, Montague County, each have six and Lupton

and Knox fields, Young County, each have five.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Archer County: Bridwell Oil Co. 1-J L. F. Wilson, Sec. 1, SPRR Sur. A-412, 6 mi. S and 1 mi. W Mankins, dry at 1,606 ft.

Clay County: W. H. Hammon 1 C. H. McClellan, Chas. F. Stanley Sur. A-407, 2 mi. W Dean, dry at 1,401 ft.

King County: Superior Oil Co. 1 Pitchfork Land & Cattle Co., Sec. 171, John H. Gibson Sur., 12 mi. NW Guthrie, elev. 2,095 ft., granite 7,142 ft., dry at 7,145 ft.

WEST CENTRAL TEXAS

ABILENE.—Continental Oil Co. will drill 1 C. P. Woody, 660 ft. from the north and west lines of the most southerly north and west lines of the D. A. Deal Survey, Abstract 2104, a wildcat to test the Ellenburger. The wildcat is 1 mile south of Poolville in Parker County. Sohio Petroleum Co. 1 Faver, Section 50, Block 21, T&P Survey, prospect in Nolan County 4 miles east of Sweetwater, pumped 7 bbl. of oil and 14 bbl. of water in 14 hours at total depth of 5,836 ft. The test has been shut in for several weeks.

Jones County Regular field, Reddin field, Taylor County, and Wimberly field, Jones County, each had one completion this week. Noodle field, Jones County, had two locations, Merkel field, Taylor County, and Santa Anna field, Coleman County, each had one. Stephens County has 17 drilling wells, 7 in Stephens County Regular field and 3 in Loving field and 7 wildcats. Jones County has 15, including 1 each in Jones County Regular field, Noodle field and Cooper field, and 12 wildcats.

MICHIGAN

Heavy Producer Completed In Coldwater Field

SAGINAW.—A Pure Oil Co. well with initial potential of 1,560 bbl. in the Coldwater field, Isabella County, was the best of 5 new producers in the week's list of 12 completions, including 2 gas wells and 5 dry holes, of which 3 were wildcat failures. Meanwhile 17 new locations were announced.

A state conservation department tabulation shows Michigan with a total of 3,536 producing oil wells, 675 gas wells, net gains in a year of 103 and 18, respectively. Production of oil, the Michigan Oil and Gas Association added, continues to drop slowly, averaging 45,260 bbl. a day, a 490-bbl. drop in a month. Arenac County production, nearly all from Deep River and Adams pools, now accounts for approximately 25 per cent of the total, almost identical with that still coming from the older Reed City field. Coldwater is up to 4,000 bbl. a day and Bay County to 3,000.

Two of the new producers are in Bay County, others in Montcalm and Allegan. The gas wells are Fork Township developments in Mecosta County. New locations include four in the Deep River field, four in Allegan County, two in Isabella County, one in in Barry, Cass, Gratiot, Mecosta, Newaygo, Tuscola and Van Buren.

MICHIGAN WILDCAT FAILURES

Gladwin County, Sage Township: Smith Petroleum Co. 1 Gordon Smith-Helen Dow, SW SW SW 22-19n-2w, dry in Dundee, TD 4,000 ft.

Gratiot County, New Haven Township: Sohio Petroleum Co. 1 Albert Joslen, SE SW SE 22-10n-4w, dry in Dundee, TD 3,253 ft.

Kent County, Grattan Township: Smith Petroleum Co. 1 R. E. Slaytor, NE SE NE 23-8n-9w, dry in Traverse Lime, TD 2,520 ft.

CALIFORNIA

New Field Discovered East of Dominguez Field

LOS ANGELES. — California prospectors have discovered four new oil fields and two gas fields in the first 2 months of 1946 and while this average will probably not be maintained for the remainder of the year it is a good start. Of the quartet of new fields added thus far in 1946, only Bandini is expected to show substantial production. California's latest oil field is East Dominguez where Shell completed its 1 Dominguez Estate pumping 250 bbl. of relatively clean oil daily from 10,478 ft. This new well is located in Section 2-4s-13w, about ¾ mile east of nearest production in the Dominguez field. It has 1,609 ft. of formation open due to perforations at various depths. Seven-inch casing had previously been landed at 8,660 ft. when a formation test had been made of the interval at 8,660-8,740 ft.

Although not definitely known it is believed quite probable that at 10,478 ft. this well is in the Miocene approximately 3,500 ft. if not more. Compaction with depth is a characteristic of this district and it is quite likely that Shell has encountered a similar condition in its 1 Dominguez Estate.

The Cymric field of Kern County continues to hold the interest of operators by the almost constant discovery of new oil sands and the lack of uniformity. Superior is believed to have found a productive oil sand in the Eocene in 67-22 Woody, but this cannot be confirmed as the company is not releasing any formation data. Production possibilities of the Eocene are important because this sand may extend over a larger area and not lens out as has been the case with several of the upper Miocene sands.

Production possibilities of the Eocene are also interesting operators in the Kern River field since Tide Water Associated found some oil sand in rocks of this age. Tide Water did not find sufficient oil sand to produce but with this formation present, additional development may be anticipated. The most significant thing in connection with this work is the fact that the Eocene has been found and identified at Kern River. A small amount was found at Fruitvale several years ago but Tide Water Associated's 154 Luck is the first well to prove its existence at Kern River. Whether it will prove commercially productive will have to be determined by future drilling.

There is no indication in the number of new locations made this week to expect any immediate change in the scope of drilling in California. Most locations were in proved fields especially in the San Joaquin Valley and the decrease that was recorded in projected wildcat work is only of a temporary nature. An increasing trend has been noted during the past few weeks in drilling at Cymric, Edison, Helm, and Wilmington and present indications point to the probable continuance of the current rate for some time to come. There have been no unfavorable developments in any of these fields to indicate a reduction in the number of drilling strings in operation. Texas Co. has apparently found a commercial gas field in the Dunnigan Hills section of Yolo County, the company's 1 Hermle making 3,000,000 cu. ft. of dry gas daily from 2,660 ft. through a 24/64-in. bean.

CALIFORNIA SUCCESSFUL WILDCAT

Los Angeles County, East Dominguez: Shell 1 Dominguez Estate, 2-4s-13w, pumped 325 bbl. 30.1-gravity, 3 per cent, TD 10,478 ft., perf. 8,660-10,478 ft., located about ¾ mile east of Dominguez field.

CALIFORNIA WILDCAT FAILURES

Kern County, East Bakersfield: Amerada 45-12 Castro, 12-30s-27e, bottomed in hard barren gray sand, only minor showings. TD 7,933 ft.

Sheep Springs-Temblor: Texas 36-19 Anderson, 19-29s-21e, bottomed in barren gray sand, no showings logged TD 1,702 ft.

Orange County, Olive: McKee Oil Co. 8-1 Kokx Comm., 16-4s-9w, bottomed in barren red silt, no showings logged, TD 4,005 ft.

Tulare County, Kingsburg: Transcal Drilling Co. 1 Harris, 34-16s-23e, bottomed in hard shale, no showings logged, TD 2,610 ft.

Ventura County, Piru: C. W. Ginter and Associated 1 Warring, 19-4n-18w, bottomed in hard gray sand, no showings logged, TD 1,480 ft.

SOUTHWEST TEXAS

New Pay Opened on West Flank of Saxet Deep Field

CORPUS CHRISTI.—A new pay on the west flank of Saxet Deep field, Nueces County, has been opened by Richardson Petroleum Co. 1 L. G. Talbert. Drilled to total depth of 7,495 ft., the new pay was topped at 6,635 ft. Perforations for the completion were made at 6,643-45 ft., with 5½-in. casing set to 7,492 ft. On potential gage this well flowed 164 bbl. of pipe-line oil daily through 7/64-in. choke, gas-oil ratio 553 to 1, tubing pressure 925 lb., casing pressure 1,050 lb., gravity 38°.

Oil production has been opened at Calvert field of Milam County, by D. A. McCrary et al 2 McCrary, David Galleher Survey. This well was completed for an initial production of 117 bbl. of clean oil per day on a ¼-in. choke, 36° gravity, no gas, from sand topped at 2,194 ft. Total depth is 2,220 ft., with 5½-in. casing set above the pay at 2,181 ft., and 2½-in. tubing to 2,186 ft. The field was opened in November by Hamman Oil & Refining Co. 1 F. W. Patzke, in the same survey, which was reported to have made 2,500,000 cu. ft. of gas from open hole at 2,012-2,220 ft. Hamman 1 Cross later made a dry hole at 2,200 ft.

The Pearsall field of Frio County received another Buda lime producer when H. W. Snowden et al 8 Cory & McWilliams flowed by heads through perforations at 5,917-32 ft. after acidization with 2,000 gal. The oil is around 42° gravity. Top of the Buda was reported at 5,929 ft. This is the second Buda lime producer for the field.

Quintana Petroleum Co. 1 Anna Spahn, wildcat 4 miles northwest of Gonzales, in Gonzales County, was reported washing down, apparently to set 5-in. casing for a production test. The hole was bottomed at 10,500 ft. A drill-stem test in the Glen Rose section is said to have recovered 600 ft. of oil and 400 ft. of oil-cut mud.

Jay Simmons 1 Mary Poehler, wildcat 2 miles northeast of South Cabeza Creek field in Goliad County, in Jacob Fifer Survey, is waiting on orders at total depth of 8,305 ft. On a 22-minute drill-stem test at 8,301-05 ft., using ¼-in. chokes, with 1,000 ft. water cushion, 1,625 lb. working pressure, this well recovered 200 ft. of condensate and small amount of water from the Massive Wilcox zone topped at 8,279 ft. The 5½-in. casing is set to 8,289 ft.

New outpost tests were announced this week in two of northern Bee County's deep Wilcox fields. H. B. Zachry Co. of San Antonio will drill 1 W. A. Boothe as an 8,000-ft. test at Ray-Wilcox field, in the W. B. Blanchard Survey. At North Pettus-Wilcox field, Union Producing Co. 1 I. Spielhagen is to be drilled to about 7,400 ft., in Geo. Habbermacher Survey.

There were 42 locations reported this week, 8 being wildcats, 2 in Webb, 1 each in DeWitt, Duval, Live Oak, Milam, Starr, and San Patricio counties. Tom O'Connor and Tijerina received 4 new starts each while South Campana and Falls City received 3 each. Of the 36 completions, 7 are

wildcats, 1 a new pay in Saxet field, Nueces County, and a pool opener in Atascosa County. The 5 dry wildcats are located 2 in Duval and 1 each in Atascosa, Bastrop and Milam counties. Duval County led with six completions reported, Kleberg and Brooks each received four, while Starr and Willacy counties received three completions each.

SOUTHWEST TEXAS SUCCESSFUL WILDCATS

Atascosa County: New gas-condensate pool —Quintana Petroleum Corp. 1 C. Muil, in J. C. Mattison Sur. 467, 11 mi. SE of Pleasanton, 5½-in. casing at 8,836 ft., Upper Edwards lime 8,836 ft., TD 9,105 ft., acidized 100 ft. open hole below casing, PT estimated 3,500,000 cu. ft. gas and 100 bbl. condensate per day through a ¼-in. choke, tubing pressure 2,000 lb., gravity 48°, no water.

Nueces County: New oil pay, Saxet field—Richardson Petroleum Co. 1 L. G. Talbert, .Russell Farm Tracts, top sand 6,635 ft. (new pay), TD 7,495 ft., perf. 12 holes 6,643-45 ft., PT 164 bbl. through 7/64-in. choke, gas-oil ratio 553 to 1, tubing pressure 925 lb., casing pressure 1,050 lb., gravity 38°, no water.

SOUTHWEST TEXAS WILDCAT FAILURES

Atascosa County: Quintana Petroleum Corp. 1 Guy H. Smith, Wm. Waggoner Sur. 201, 13 mi. SE of Pleasanton, dry 6,065 ft.

Bastrop County: Joe O. Williams et al 1 A. E. Rosanky, Musgrove Evans Sur., 12 mi. S of Bastrop, dry 1,965 ft.

Duval County: S. Robertson 1 E. R. Hagist, BS&F Sur. 124, 20 mi. N of Freer, dry 2,635 ft.

Duval County: Rowan & Hope 1 The Duwel Co., J. Poitevent Sur. 549, 3 mi. N of Rosita, dry, at 2,506 ft.

Milam County: Holcomb & Howard Oil Co. 1 J. L. Byrd, J. J. Acosta Grant, 9 mi. W of Rockdale, dry at 1,133 ft.

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ROCKY MOUNTAIN

New Field Discovered in Fremont County, Wyoming

DENVER.—A new oil pool far away from the beaten path of the wildcatter has been discovered in the northwestern corner of Fremont County, Wyo., in Sinclair-Wyoming Oil Co. 1 Dubois Unit, NE NE NE 11-42n-107w, on the Dubois structure immediately northwest of the town of that name. It is 35 miles west of the Circle Ridge field in the Wind River basin and 60 miles southwest of Oregon Basin in the Big Horn Basin. No wildcats have ever been drilled in the district nor in the 60-mile stretch between its location and the Idaho boundary. The location for the test was made in the summer of 1944, but drilling did not begin until a year later. Early last month, when the hole had reached a depth of 3,571 ft., the rig caught fire and burned down. Nothing had been made public up to that time concerning the formations being drilled nor the results. After repairing the fire damage the hole was plugged back to 2,155 ft. and the 7-in. was cemented at 1,979 ft. A swabbing test the past week yielded 80 bbl. of oil in 24 hours from the Embar sand. The Stanolind pipe line from Elk Basin to Casper runs near the new pool. The hole was 1,501 ft. below the top of the Embar when the fire occurred.

Rangely field outposts.—Two key wells on the north and west sides of the Rangely field give indications of being close to the edge of the pool although both are being completed as good producers. Algord Oil Co. 1 Guiberson C SE NE 18-2n-102w, ½ mile north of the nearest well, flowed 1,000 bbl. in 44 hours through a 1-in. choke showing 1 to 1½ per cent salt water and 18 per cent basic sediment. The tubing pressure was 40 lbs., and casing pressure 200 lbs. The oil-water contact is placed at between 6,504-10 ft. Top of the Weber was at 6,320 ft., measured by samples, and 6,334 ft. by electric survey. Total depth is 6,575 ft.

Continental Oil Co. 1 Rooth C NW SW 15-2n-103w, located 1½ miles northwest of the nearest producer, was drilled to 6,816 ft. A drill stem test at 6,794-6,816 ft., recovered 18 stands of salt water in 2 hours. Top of the Weber was at 6,581 ft. The hole showed excellent saturation down to where the drill stem test was made and will be completed as a good producer. It is plugging back with special materials other than cement to shut off the bottom hole water. The two wells are nearly 3 miles apart.

Although several sets of figures are being used to determine elevations, some based on sample measurements and others on electric surveys, with ground and rotary table elevations, the following correlation of logs on rotary table elevations are accepted by the operators: Top of Weber in the Algord well is placed at —989 ft. and in the Rooth well at —964 ft., total depth —1,220 in the Algord and —1,199 in the Rooth wells.

Greasewood stages come-back.—The Greasewood Flats area in Weld County, Colo., which set off a big boom in 1930 when oil was discovered in a wildcat drilled by a local company, is back in the picture in Colorado Unit Corp. 1 Kirchoff C NW NE 11-6n-61w, which is showing for a good well. Three producing wells were drilled in the pool, but several tests drilled around them were abandoned although most of them had good shows in the pay horizon. The producers were drilled in to the sand with cable tools. The dry holes were drilled with rotaries. R. S. Shannon, president of the Colorado Unit Corp., who was in charge of the completion of one of the old wells, has held to the theory that peculiar conditions existing in the producing horizon made rotary comoletions impracticable. The bottom hole temperature was 230° Fahrenheit and he claimed that the heat caused the mud to bake into the walls of the holes and seal off the oil. The tools, although

drilling in water, would come out dry. As a result, drill stem tests failed to reveal any appreciable quantity of oil. The Kirchoff well, located 2 miles northwest of the nearest producer, with a rotary-drilled dry hole between, was spotted to test out the theory. At 6,620 ft., the 7-in. was cemented and equipment was standardized. It picked up a hard, black vitrolic caprock at 6,752 ft. This was penetrated in 1 foot and immediately beneath it gas was encountered, followed by oil, which rose 3,500 ft. in the hole with the bottom at 6,758 ft., 5 ft. in the sand. The top 200 ft. of fluid was almost pure gasoline and evaporated in a few seconds. The remainder is about the same quality as the Greasewood oil, around 40° gravity. Tubing is being run for a test at the present depth, after which it will be drilled 10 to 15 ft. deeper before completing.

New operations.—Thirteen new operations were reported, of which six are in Colorado, five in the Rangely field and one in the Iles pool in Moffat County; two in Wyoming, one each in Big Sand Draw and East Lance Creek; three in Montana, of which one is in Cat Creek and two in Cut Bank; and two in northwestern New Mexico, both in the Fulcher Basin gas fields. All are development wells with the possible exception of the one in the Iles field, Stanolind 23 Iles NW SW SE 22-4n-92w, which may be the long-projected Weber sand test.

One of the new operations of particular interest is Sinclair-Wyoming Oil Co. 3 Sand Draw Unit, SW SW SE 10-32n-95w. It is located ½-mile northwest of the Tensleep sand discovery late in 1944 which made 1,100 bbl. per day. Only one other well has since been drilled. The third location follows the conclusion of a deal whereby Sinclair acquired the holdings of the Unit Oil Co. in the unit from R. S. Shannon. The Unit company retained its acreage north, south and east of the unit.

Completions.—Seventeen wells were completed, of which 9 were oil wells with initial production of 1,874 bbl. One completion was in the Rangely field in Colorado for 624 bbl. Wyoming had 6 completions, of which 5 were oil wells for 1,111 bbl., and 1 a wildcat, was a dry hole. Montana had 7 completions, of which 3 were oil wells for 139 bbl., and 4 were dry holes. New Mexico had 3 completions, all gas wells, 2 in Fulcher Basin and 1 in Barker Creek.

WYOMING SUCCESSFUL WILDCAT

Zimmerman Butte, Hot Springs County; Pacific Western Oil Corp. 1 Government C SE 35-44n-93w. TD 1,123 ft., top Frontier 1,115 ft., averaged 3 bbl. per day 35.3° gravity on pump. Drilled to test show passed up in drilling Embar discovery.

WYOMING WILDCAT FAILURE

Saratoga, Carbon County: Arp & Snively 1 Seaverson SW SE SW 30-18n-84w, dry at 3,635 ft., probably in Dakota.

MONTANA WILDCAT FAILURE

Cut Bank, Glacier County: Union Oil Co. 4 Langenbeer NW NE NW 18-35n-5w., TD 3,130 ft., top of Madison 3,065 ft., trace of oil and water at 3,110-18 ft., 2,100 ft. of water at 3,125-30 ft., PB 2,940 ft., standing.

LA.-ARK.

Extension in Prospect For Haynesville Field

SHREVEPORT.—Oil and 20 per cent salt water was swabbed at 5,632-48 ft. from the Skelly Oil Co. 1 Myrtis Pipes Unit in Columbia County, Arkansas. The well is 1,103 ft. north and 660 ft. east of the southwest corner of 26-19-20, Haynesville field, and may extend the pool slightly to the northwest. TD is 5,704 ft. Operators squeezed and reperforated at 5,632-48 ft. After the hole was acidized and oil circulated, 80 per

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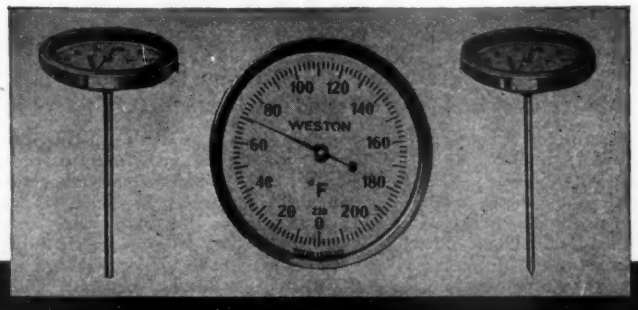

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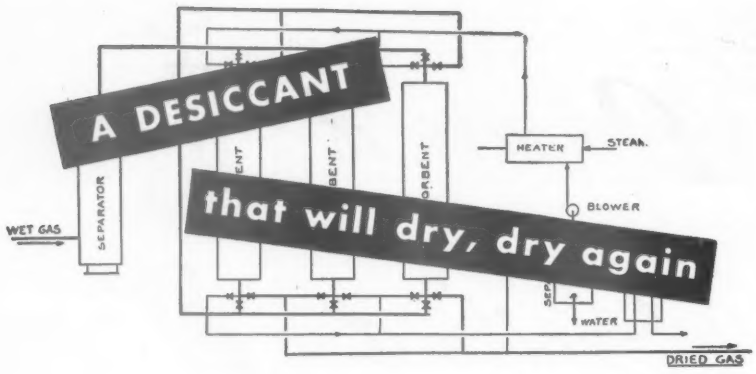

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cent oil was swabbed. Testing is being continued.

Another prospective producer for Columbia County, in the Village field, is flowing 125 bbl. oil and 20 per cent salt water into pits per day. The well, McAlester Fuel Co. A-1 Z. P. Duncan, SE NW 10-17-19, was deepened to 7,410 ft. Cement sheathing was perforated at 7,404-6 and packer set at 7,400 ft. Operators are testing.

Arkansas had two dry wildcats and one successful wildcat in Union County. A producer was added to the Smackover pool and a dry hole to the Wesson pool.

Big Chief Drilling 1 Franklin was coring from 3,401 ft. The well is in SW SE of 7-17n-9e, two miles north of the Delhi field in Franklin Parish, Louisiana.

A wildcat in Bossier Parish, H. C. Owens 1 Skidmore, NE NE of 1-16n-11w, was perforated a second time at 5,322-30 ft. A drill stem test recovered water, and perforations were squeezed. Total depth of well is 5,365 ft.

Ten wells were completed in North Louisiana. A wildcat in Ouachita Parish was dry and five field wells were dry. Lake St. John field, Big Creek, East Haynesville, and New Delhi fields each had one producer.

NORTH LOUISIANA WILDCAT FAILURE

Ouachita Parish: California 1 Walter Maxey, SW NE 32-18n-11w, dry at 9,331 ft.

ARKANSAS SUCCESSFUL WILDCAT

Union County: Atlantic Refining Co. 1 H. R. F. Goode, S½ N½ NE NW 6-17s-13w, 34 bbl. oil from Smackover lime at 5,637-47 ft., TD 9,331 ft.

ARKANSAS WILDCAT FAILURES

Miller County: Garland Anthony et al 2 A. W. Smith, NW NW SE 24-15s-26w, dry at 4,610 ft.

Union County: Curtis Kinard 1 E. P. Hammond, NW NE NW 19-17s-15w, dry at 3,702 ft.

OKLAHOMA

New Gas Pool Opened In Seminole County

A NEW gas producing area has been opened north of Wewoka in Seminole County by C. R. Ross 1 Hall, NW SE SE 3-9n-8e. It is being completed for 10,000,000 cu. ft. daily from the Gilcrease sand encountered at 3,214-40 ft. Rock pressure was approximately 1,150 lb. Oklahoma Natural Gas Co. is preparing to connect to the well and run the gas. Ross assembled a block of 400 acres in this area before drilling the test and contemplates further development in the near future.

Interest in all known favorable acres of Washita County has been greatly increased as a result of a flow of gas tested by Atlantic Refining Co. in its community test, 1 Hill, NW NW NW 25-8n-18w. A drill-stem test at 6,170-90 brought an estimated flow of 10,000,000 cu. ft. of gas in 40 minutes. Flowing pressure was 1,650 lb. and shut-in pressure was 3,100 lb. In a second drill-stem test from 6,190-6,225 ft. the well flowed 15,000,000 cu. ft of gas. The first test was reported as wet gas but operators say both shows were dry gas. Producing formation is not definitely known, but it has been tentatively called Pennsylvanian. The 1 Hill, originally scheduled as an Ordovician test to go to 5,500 ft., is drilling ahead below 6,325 ft.

The Aylward Producing Co. 1 Lytal, SE NE SW 16-6n-8e, a wildcat near the Southeast Spaulding pool of Hughes County, has set 5-in. casing at 2,595 ft., after encountering saturation in the Booch sand topped at 2,600 ft. Total depth of the test is 2,624 ft.

Another wildcat was showing prospects of opening a Booch sand pool in Seminole County at the close of the week. R. P.

Traugh et al 1 Roberts, NW SW SW 13-7n-7e, on the northwest edge of the Fish pool, encountered the Booch at 3,150-95 ft. and cores showed good saturation. A string of 5-in. casing has been cemented at 3,115 ft. and operators are waiting on cable tools.

OKLAHOMA SUCCESSFUL WILDCATS

Hughes County: William Bartlett 1 Harjo, NE NW SE 6-7n-9e, 20 bbl. oil from sand at 2,835-52 ft., TD 3,698 ft., sand 3,088-95 ft.

Okfuskee County: Public Service 1 Rose NW SE 28-10n-12e, 3,250,000 cu. ft. gas from Gilcrease at 2,370-82 ft., TD 2,382 ft.

Pontotoc County: J. E. Crosbie 1 Kelly, NE NE SW 9-4n-7e, 10,000,000 cu. ft. gas from Atoka sand at 1,811-13 ft., TD 4,456 ft., Wilcox 4,408 ft.

Seminole County: C. R. Ross 1 Hall, NW SE SE 3-9n-8e, 6,700,000 cu. ft. gas from Gilcrease at 3,213-49 ft., TD 3,533 ft.

OKLAHOMA WILDCAT FAILURES

Lincoln County: J. W. Sorrells 1 Porter, NW NW NW 28-15n-5e, dry at 3,522 ft.

Okfuskee County: Brown & Tomer Drilling Co. 1 Rhea, NW NE SW 14-10n-9e, dry at 3,278 ft.

Seminole County: H. H. Wegener 1 Robertson, NW NE SW 31-9n-7e, dry at 3,430 ft. Seminole Oil & Gas Co. 1 Killingsworth, NE NE SW 9-8n-7e, dry at 4,207 ft.

OHIO, KENTUCKY

Large Gas Well Completed In Washington Township

COLUMBUS.—E. P. Mellon 5 Esther Booth, Lot 38, adds a good Berea sand well to the combination Berea and Oriskany pool in Washington Township, Tuscarawas County. Second sand, logged at 1,181-84 ft. gaged 2,400,000 cu. ft.

Two wells were completed in the Bloom Township, Morgan County area. Mt. Vernon Car 2 Clark Van Horn, Section 8, gaged 1,900,000 cu. ft. from Clinton sand at 4,369-95 ft. Ohio Fuel 3 R. F. Williams, Section 5, gaged 831,000 cu. ft. at 4,077-87 ft. in the Clinton.

The North Canton area has become a town lot drilling proposition now with about 30 strings of tools working. As it is a residential and industrial area, it is hard to consolidate leases of any size. Twenty-three locations were reported for the week with Brush Creek having six, Ashland five, Lancaster and Sandyville each four. Of the 19 completions, Ashland and Lancaster led with 5 each.

OHIO SUCCESSFUL WILDCAT

Columbiana County, Knox Township: Snee and Eberly 1 B. Humphrey, Sec. 34, Clinton 5,366-5,469 ft., 180,000 cu. ft., TD 5,582 ft.

OHIO WILDCAT FAILURE

Mahoning County, Ellsworth Township: Smith and Galey 1 F. W. Cramer, Sec. 14, Oriskany 3,299-3,314 ft., TD 3,377 ft.

EASTERN KENTUCKY

ASHLAND.—The Kentucky and West Virginia Power Company stepped up activities in the eastern Kentucky field during the past week, completing two wells for total production of nearly 1,000,000 cu. ft of gas daily.

Well 799 on the Clay Martin property in Knott County was completed at a total depth of 2,736 ft., with daily open flow of 273,000 cu. ft. in Shale after shot.

Well 5201 was completed on the Elswick property in Pike County, total depth 1,576 ft., with a daily open flow of 671,000 cu. ft. in Maxon.

WESTERN KENTUCKY

OWENSBORO.—Western Kentucky operations continued quiet during the past week, with no important wildcat developments reported. Two oil wells and three dry holes, one a wildcat, were completed. Three new operations were reported, one each in McLean, Daviess and Union counties.

WESTERN KENTUCKY WILDCAT FAILURES

Union County: H. H. Weinert 1 Union County Trust Co., 19-0-18, elev. 387 ft., dry at 2,596 ft., Menard 1,592 ft., Viola 1,774 ft., Glen Dean 1,862 ft., Golconda 2,018 ft., Barlow 2,144 ft., Renault 2,375 ft., Ste. Genevieve 2,484 ft.

INDIANA

EVANSVILLE.—The Continental Oil Co. has derrick and rig on location and are ready to begin drilling at 1-D Cooper Estate, SW SW, 13-3s-14w. This well is to be a Devonian test and is scheduled to go to about 6,200 ft. It is the first deep test to be drilled in the Griffin field. Principal production in this field at the present time is from the sands of the Chester series.

Indiana reported six completions during the week, only one of which was a failure. Two new operations were started and permits were issued for three more.

CANADIAN FIELDS

Turner Valley Extension Tests in Final Stages

CHATHAM.—Two tests by Home Oil in the effort to develop production north and west of the Turner Valley North Extension area are in their final stages. Home Oil 21, LSD 11, 34-21-4w5, the outlying test, finished in the lower portions of the Madison at 9,582-9,826 ft. with water indicated, and will probably be abandoned. Home 20, LSD 7, 24-21-4w5, 2 miles south and east, but northwest of production, got the Madi-

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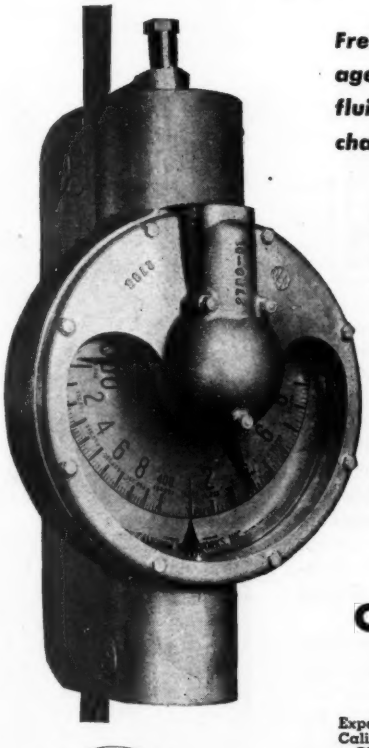

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son lime at 9,303 ft. with oil and gas shows in the upper porous, and is deepening to the lower zone below 9,577 ft. The two wells tested possibilities of a supposed uplift stretching 4½ miles north of the most northerly previous producers.

Further exploring the possibilities of extension, Home 22 has been located in LSD 10, 32-20-3w5, and Home 23 in LSD 7, 5-21-3w5, both west flank tests outside the proven area.

Hay River.—An important exploratory venture in the North West Territories is being undertaken by T. Boyd Kyle and associates of Calgary who are moving drilling equipment into the Hay River district to test a concession of 100 square miles on which extensive surveys have already been made. Hay River enters Great Slave Lake from the south, near its western end, and the concession is about 12 miles upstream. Preliminary reports indicate the Devonian limestone, productive in the Norman Wells area on the Mackenzie, is the chief potential oil horizon. Inconclusive drilling operations by White Beaver Oil Co. in 1921-22 failed to get commercial production. Drilling starts in Cretaceous sandstones with Devonian extending from a shallow depth of approximately 2,000 ft. The White Beaver tests, apparently flank wells, were lost through mechanical difficulties or salt water. Hay River Oil Exploration Syndicate, organized to handle the development, is moving in a heavy diamond drill for the initial tests, utilizing the 300-mile winter tractor road from Grimshaw, near Peace River.

Ontario.—A series of tests for oil will be drilled by Imperial Oil in the north end of Yarmouth Township, in Elgin County where 1,200 acres have been leased in Concessions 11 and 12. Attention was attracted to the area, located east of former oil production near Dutton and Wallacetown, when oil was struck in water wells drilled at the Fingal Bombing and Gunnery School early in the war. Drilling will start this spring.

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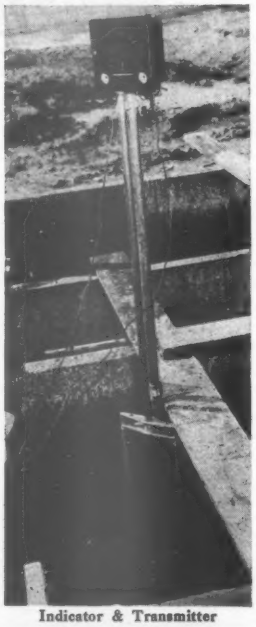

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APPALACHIAN FIELD

Tucker County Wildcat Opens Oriskany Gas Field

PITTSBURGH.—The second wildcat of the Ohio Oil Co. on the Kuykendall Unit on the Blackwater anticline in Dry Fork district, Tucker County, West Virginia, is being completed as an Oriskany gas well and is gaging in excess of 3,000,000 cu. ft. a day with part of the sand untested. This test starts at a surface elevation of 3,342 ft. with the Onondaga lime topped at 8,107 ft., Oriskany 8,250 ft., Helderberg 8,380 ft., total depth 8,404 ft. Progress through the Oriskany sand was difficult and drilling was suspended at 8,305 ft. where a string of 7-in. pipe was run and landed on bottom. This shut off the top 55 ft. of sand from which it is believed there was some show of gas in the drilling mud.

After cleaning out the hole, the highest natural gage was 970,000 cu. ft. It was first acidized with a light load of 500 gal., which increased the gas volume, and then reacidized using 4,500 gal., first killing the well with water. After clearing itself, it gaged 3,773,000 cu. ft. gas and rocked up to 3,200 lb. in 2½ hours. The casing which shuts off the upper part of the Oriskany from 8,250-8,305 ft. will be perforated and tested as may various pays in the upper Devonian shales.

The original test on this structure, about 1 mile north and slightly east, topped the Oriskany sand at 7,877 ft. where trouble was encountered. With the rotary, a window was milled in the casing at 7,500 ft. and the hole redrilled to the sand. Much difficulty was met in the redrilled section and finally it was shut down in the Oriskany sand where a perforated tubing test showed about 92,000 cu. ft. with the weight of the mud still on the sand. After being shut in for some time, it was opened and cleared itself of mud. It has a gage of 1,500,000 cu. ft. gas at the present time.

This second good gas well moves the Appalachian frontier of the central eastern states eastward, leaving between it and the proven fields to the west many continuous structures on which there are apparent closures. While there have been scattered tests on some of these with disappointing results, the new gas strike encourages belief that more work will be done.

New locations announced during the week totaled 14 and are located in Elk and Union districts, Barbour County; Buffalo district, Clay County; Ravenswood and Washington districts, Jackson County; Laurel Hill district, Lincoln County; Clear Fork district, Raleigh County; Grant and Murphy districts, Ritchie County; Clay and Reedy districts, Wirt County, and Center and Oceana districts, Wyoming County.

In Luzerne Township, Fayette County, southwest Pennsylvania, Peoples Natural Gas Co. completed a Big Injun sand gas well in the second test on Harry R. Hogsett farm with an open flow, natural, of 9,375,000 cu. ft. The Injun sand was topped at 1,820 ft., and the first good gas pay at 1,944 ft.

In Fairfield Township, Westmoreland County, Peoples Natural Gas Co. is drilling at 7,024 ft. in the Oriskany test on Camilla Giffin farm where the formation is now limy. This may indicate the top of the Onondaga lime and will probably be confirmed as soon as the chert is reached.

New locations during the past week totaled eight. These are located in Kiskiminitas and Monor Townships, Armstrong County; Cumberland and Franklin town-

ships, Greene County, and German and Springhill townships, Fayette County.

KANSAS

Butler County Wildcat Testing Show of Oil

THE testing of a show of oil in the Bartlesville is reported from the Nadel & Gussman 1 Crowley, SW SW SE 11-28-5e, wildcat in Butler County. The test is 1½ miles north of the Fox Bush pool and 1½ miles southwest of the Weaver pool. The Bartlesville was logged at 2,692 ft. Pipe was set on top of the formation and the sand section was drilled to the top of the Mississippi at 2,736 ft., total depth 2,738 ft.

Production in the Salina pool was extended ½ mile west by the Currier & Keys Drilling Co. 1 Crawford, SE NW NW 18-14-2w. The well pumped 50 bbl. of oil, natural, per day. Operators are testing after acidization.

Continental 39 Strat Test, NW SE SE 34-11-23w, wildcat in Trego County, was drilled to 3,831 ft. and perforated at 3,804-31 ft. with no show of oil. After acidization, 7 bbl. of water per hour was swabbed with a trace of oil. Operators squeezed perforations.

Kansas had 37 completions of which 18 were oil, 4 were gas and 15 were dry.

KANSAS SUCCESSFUL WILDCATS

Barton County: Virginia Drilling Co. 1 Howell, SE SE NE 36-18-15w, 100 bbl. oil from Arbuckle at 3,459-3,502 ft., TD 3,502 ft.

Cowley County: Fred Manning 1 Lester, NW SW NW 23-33-3e, 5 bbl. oil from Bartlesville sand at 3,290-3,303 ft., TD 3,344 ft.

KANSAS WILDCAT FAILURES

Marion County: Ward McGinnis 2 Loveless, NE NE SW 2-19-4e, dry at 2,411 ft.

Saline County: C. C. Nelson Drilling Co. 1 Blair, NW NW SW 22-16-3w, dry at 3,564 ft.

Sedgwick County: Beech 1 McLean (Fourth

(Continued on page 123)

ILLINOIS

New Field in Prospect For Jefferson County

MATTOON.—In Jefferson County, about 6 miles southeast of Mt. Vernon, the Gulf Refining Co. has set pipe at a total depth of 2,923 ft. at the 1 Gale Knox, NE NE SE 4-3s-4e. A 1-hour drill-stem test of the Aux Vases sand at 2,898-2,923 ft. got gas in 26 minutes, 2,133 ft. of clean oil and 60 ft. of oil-cut mud, no water. The 1 Knox is 2 miles from other oil production and shows good prospects of opening a new pool.

In the Mattoon field of Coles County, National Consumers Oil Co. is continuing to test the Devonian lime at the 3 M. B. Herkimer, SE NW NE 11-12n-7e, at a total depth of 3,170 ft. On the latest test, after an acid treatment of 2,000 gal., the well flowed 67 bbl. of load oil in 10 minutes, 4,800,000 cu. ft. gas, a spray of salt water and a show of oil.

A Christian County wildcat, John Wrather 1 T. M. Thompson, SE SE SE 15-15n-2w, is being put on pump to test the Devonian at 1,971-77 ft. total depth 1,997 ft. On swab tests this well recovered oil at the rate of 37 bbl. per day. It is about 2 miles north of the Mt. Auburn field.

Illinois completions during the past week totaled 34, of which 23 were oil wells and 11 were dry. The dry holes included 5 wildcat failures. New operations amounted to 24, including 5 wildcats. Cole County received the largest amount of the new work, with eight new wells reportedly underway in the Mattoon field.

ILLINOIS WILDCAT FAILURES

Coles County: George & Wrather 1 R. J. Tivnen, NW SW SW 26-13n-7e, dry at 1,960 ft.

Cumberland County: Jarvis Bros. & Marcell 1 Miller, SE NE NW 20-10n-7e, dry at 2,326 ft., Glen Dean 1,856 ft., Barlow 1,942 ft., Cypress sand 1,987 ft., Renault 2,150 ft., Aux Vases sand 2,158 ft., Ste. Genevieve 2,212 ft., Rosiclare 2,248 ft.

(Continued on page 130)

MISSISSIPPI

Discovery Well Opens Pool in Adams County

JACKSON.—A new field has been opened in Adams County with the discovery well, Roeser & Pendleton, Inc., and Sohio Petroleum 1 Baker-Maier, 34-6n-2w, flowing 97 bbl. of 39.2-gravity oil through a ¼-in. choke from the Tuscaloosa at 10,544-49 ft. The well started making 3 bbl. oil per hour after perforations at 10,544-49 ft. and then died. Perforations were plugged and the well acidized. Operators ran 2-in. tubing with packer at 10,503 ft., cleaned out and put on ¼-in. tubing choke. Total depth of the well was 10,673 ft.

Magnolia Petroleum Co. 2 Ruth Pidgeon, 27-17n-4e, Warren County wildcat, had a show of oil in soft porous sand at 1,477-83 ft. A fourth drill-stem test at 1,472-77 ft. with ¼-in. top and bottom blew gas. Operators are coring below 1,487 ft.

Mississippi had three completions with one dry wildcat in Warren County. One oil well was completed in the Baxterville field in Lamar County, and one in the Eucutta field in Wayne County.

***MISSISSIPPI WILDCAT FAILURE**

Warren County: Frontier Oil Refining Corp. 1 F. C. Martin, NW NW 1-16n-5e, dry at 8,880 ft. Massive sand 8,698-8,720 ft. and 8,741-8,805 ft.

CALENDAR

March

Society of Automotive Engineers, German engineering evaluation meeting, Rackham Educational Memorial, Detroit, March 4.

New York Nomads, Louis Sherry hotel, New York, March 4.

Houston Nomads, River Oaks country club, Houston, March 5.

Oklahoma Utilities Association, annual convention, Biltmore Hotel, Oklahoma City, March 11-12.

Los Angeles Nomads, Mayfair hotel, Los Angeles, March 13.

Southern Gas Association, annual convention, Galveston, March 21-22.

Western Petroleum Refiners Association, annual meeting, Blackstone Hotel, Fort Worth, March 25-27.

American Gas Association, conference on industrial and commercial gas, Commodore Perry Hotel, Toledo, March 29-30.

American Institute of Chemical Engineers, regional meeting, Rice Hotel, Houston, March 31 to April 3.

April

New York Nomads, Louis Sherry hotel, New York, April 1.

FPC regional hearing in natural-gas investigation, House of Delegates Chamber, State Capitol Building, Charleston, W. Va., April 2.

American Association of Petroleum Geologists, annual meeting, Stevens Hotel, Chicago, April 3-5.

Midwest Power Conference, Palmer House, Chicago, April 3-5.

Los Angeles Nomads, Mayfair hotel, Los Angeles, April 10.

A.P.I. division of production, Pacific Coast district, spring meeting, Biltmore Hotel, Los Angeles, April 11-12.

Interstate Oil Compact Commission, spring meeting, Tulsa, April 11-13.

Natural Gasoline Association of America, annual convention, Baker Hotel, Dallas, April 17-19.

National Petroleum Association, semiannual meeting, Hotel Cleveland, Cleveland, Ohio, April 18-19.

Southwestern Gas Measurement Short Course, Norman, Okla., April 23-25.

A.P.I. directors' meeting, Blackstone Hotel, Fort Worth, April 28.

Independent Petroleum Association of America, midyear meeting, Houston, April 29-May 1.

May

Pennsylvania Gas Association, Galen Hall, Wernersville, Pa., May 7-9.

Natural Gas Department, American Gas Association, annual spring meeting, Hotel Gibson, Cincinnati, May 7-8.

National Association of Corrosion Engineers, annual meeting, President Hotel, Kansas City, Mo., May 7-9.

Petroleum Industry Electrical Association and Petroleum Electrical Supply Association, eighteenth annual joint conference, Mayo Hotel, Tulsa, May 7-9.

Los Angeles Nomads, Mayfair hotel, Los Angeles, May 8.

A.P.I. division of production, Southwestern district meeting, Washington - Youree Hotel, Shreveport, May 17-18.

June

Society of Automotive Engineers, semiannual meeting, French Lick, Ind., June 2-7.

A. P. I. division of production, Mid-Continent district meeting, Skirvin Hotel, Oklahoma City, June 6-7.

Kentucky Oil and Gas Association, annual meeting, Hotel Lafayette, Lexington, June 7-8.

Los Angeles Nomads, Mayfair hotel, June 12.

A.P.I. division of production, spring meeting, William Penn Hotel, Pittsburgh, June 13-14.

American Society for Testing Materials, annual meeting, Buffalo, June 24-28.

July

Los Angeles Nomads, Mayfair hotel, annual meeting and party, Mayfair hotel, July 10.

September

Los Angeles Nomads, Mayfair hotel, September 11.

National instrument conference, sponsored by Instrument Society of America, William Penn Hotel, Pittsburgh, September 16-20.

October

Los Angeles Nomads, Mayfair hotel, October 9.

November

Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa, November 7-8.

Los Angeles Nomads, Mayfair hotel, November 13.

December

Los Angeles Nomads, Mayfair hotel, December 11.

1947

May

International Petroleum Exposition, Tulsa, May 17-24.

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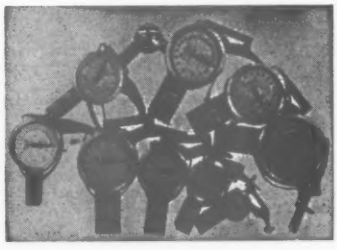

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Among the

Drilling Contractors

J. W. Drilling Co. has the contract to drill the 1 Jeffrey Jones, a wildcat in 4-3n-13w, Allegan County, Michigan, for J. F. Reed.

Olsen-Blount Drilling Corp., Oklahoma City, is drilling at 3,291 ft. on R. Olsen 1 Steeler, in C SW SW 20-23s-37e, Lea County, New Mexico. Other activity of this contractor in Lea County is as follows: The R. Olsen Oil Co. et al 1 Boyd, in C SW SW NE 23-22s-37e, is drilling at 5,920 ft. The Olsen-Blount Drilling Corp. and Western Gas Co. 1 Eaton, in C SW SW 12-25s-37e, completed through perforations in casing from 4,765 to 4,795 ft. for 9,000,000 cu. ft. of gas per day after acidizing with 1,000 gal. The Culbertson-Irwin 1 Gutman, in C SW NE 18-24s-37e, was set to surface and was waiting on cement.

George W. Miller Drilling Co. will drill the Ben Duncan & Curtis C. Long 2 Harry O. Miller, in NW SW 18-9n-5w, Owen County, Indiana.

R. E. King Drilling Co. will drill the M. E. Holloway and Raymond Whyte 2 Vernie Jankowski. The well is in NE SE NE 23-19n-4e, in the Deep River pool, Arenac County, Michigan.

Jack Grace, Wichita Falls, is contractor for Continental Oil Co. 1 C. P. Woody, wildcat 660 ft. from the north and west lines of the most southerly north and west lines of the D. A. Deal Survey, Abstract 2104, Parker County, Texas.

George & Wrather Drilling Co. has the contract to drill the 2 Brevoort, in NW NW 10-2n-11w, Knox County, Illinois, for J. E. Bauer of Vincennes, Indiana.

William B. Host Drilling Co. has been contracted by Freeman Oil Co. to drill the 1 Clyde Nott, in NW NE SW, 24-19n-4e in the Deep River pool, Arenac County, Michigan.

E. F. Moran Drilling Co. was awarded the contract to drill the first deep test in the Griffin pool, Gibson County, Indiana, by Continental. The well is 1 D. Cooper Estate, in SW SW 13-3s-14w.

Kirkpatrick & Bale, Inc. has been awarded drilling contract on the Allied Materials Co. 1 Gray-C, in NW NW SE 10-1s-3w, Carter County, Oklahoma. Contractor was drilling at 2,012 ft. on the Allied Materials Co. 1 Gray, in NE NE SE 9-1s-3w, Carter County.

Penrod Drilling Co. has been awarded drilling contract by H. L. Hunt, who has taken over and will deepen the Gulf Oil Corp. 1 Hill, in southeast of Section 9, Block B-11, of P. S. L. Survey, Winkler County, Texas, which was abandoned at 4,170 ft. about 10 years ago. New contract calls for 8,000 ft.

Union Drilling & Producing Co. will drill a wildcat in Newago County, Michigan. The well is Byron MacCallum and Fred W. Craft, Jr. 1 State-Barton, in west half of NW SW 35-16n-11w.

E. F. Moran has the contract from Continental Oil Co., which has moved in for the 1-D Cooper estate, in SW SW 13-3s-14w, Gibson County, Indiana, 3 miles northeast of Grayville, for a Devonian zone test. Test may go to 6,200 ft.

C. E. O'Neal has drilling contract on the C. P. Chandler 1 McLin, wildcat in NE SW 32-1s-8e, Wayne County, Illinois, which was drilling at 1,800 ft. Test is a Pure Oil Co. farmout.

Turner Drilling Co. will drill the 2 Bertha M. Moll, in NW SE SW 28-16n-3w, in Isabella County, Michigan, for Cities Service Oil Co.

War-Brad Drilling Co. is building board road to location preparatory to drilling the Texas 1 M. M. Baird, in SE NW SW 26-1s-5e, Wayne County, Illinois.

Drilling Association Studying Permian Basin

DALLAS. — The research program of the American Association of Oilwell Drilling Contractors is being devoted during the first year to a study of drill-stem problems in the Permian basin of West Texas and New Mexico. The entire program is being financed by voluntary contributions from drilling contractors who are mostly interested in Permian basin operations. Serious thought is

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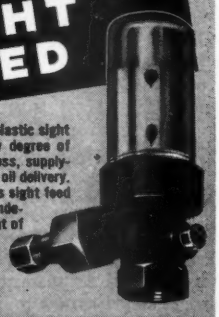

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being given to abrasion and mud practices, and it is believed such areas as California, Illinois, the Gulf Coast, Mid-Continent, Rocky Mountains, and others will benefit from these extensive studies.

Serious thought also is being given to enlargement of the research work to include the more acute problems common to every area.

Oil Men Ask Governor's Aid In Housing Texas Group

AUSTIN.—Texas oil operators are appealing to Governor Stevenson to support their request to the Board of Control to give the Railroad Commission's oil and gas division adequate quarters in the newly purchased Tribune building.

The division, custodian of valuable engineering and statistical records, must vacate by April 1 the former funeral home where it has been housed. Some space for records has been given the division in the state's Tribune building penthouse, but the oil industry group headed by V. E. Cottingham, Midland, contend surplus money from the Texas oil regulatory tax was sufficient to pay for the entire building. At a meeting here last week, Fred Brown, on behalf of the Eastland oil operators, offered the division three and a half floors plus a basement in Eastland.

New Oil and Gas Pool Map Of Oklahoma Is Completed

A new oil and gas pool map of Oklahoma has been completed by E. C. Jacobson, Tulsa. The map measures 54 by 72 in. and is built on a scale of 1 in. equals 4½ miles. Oil fields are shown in green, gas pools in red and the producing areas are named according to official nomenclature designation. The state is divided by sections, townships and ranges with all county seats designated. Jacobson recently occupied new quarters at 516 Mayo Building.

Kansas Fields

(Continued from page 121)

National), NW SE NW 1-27-1e, dry at 2,411 ft.

MISSOURI

ST. JOSEPH.—A rush developed to J. E. Palensky's No. 1 O. O. Wallace, 10 miles north of Maryville, Nodaway County, when the operators reported a showing of oil in their rotary test at total depth of 2,025 ft. An electric log, taken 2½ ft. lower than the derrick floor, gave total depth as 2,015 ft. and the porous zone as the last 3 ft. While waiting for pipe, the operators started to core and suffered a twistoff at 1,500 ft., and operators are fishing at present. The exact zone of the rainbow showing was not determined. According to the electric log, the top of Mississippi lime is at 1,847 ft. and the section from which the showing presumably originates has much shale. Rotary table elevation is 1,168 ft.

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PERSONALS

Former Professor, PAW Aide Heads Gas Company

EXPERIENCE as an oil and gas law professor, conservation commission attorney and in the government's petroleum activities lies behind the new president of Interstate Natural Gas Co., Inc.

George A. Wilson, whose election as head of the Standard Oil Co. (N. J. affiliate) has been announced, is a 36-year-old native of the Louisiana oil country. He attended public schools in Mansfield, was graduated from Centenary College in 1929 and received a law degree from Tulane University in New Orleans in 1933.

Specializing in oil and gas matters, Wilson practiced law in New Orleans for 7 years, serving parttime as professor of oil and gas law at Tulane. In 1940, he was named general counsel of the Louisiana Conservation Commission and the Department of Minerals.

When Wilson went to Washington in April, 1942, he was on leave from the Louisiana division of New Jersey Standard where he headed production, pipe line and crude oil legal activities at Shreveport. In Washington he became director of the supply and transportation division of the Petroleum Administration for War.

As president and a director of Interstate Natural, Wilson will maintain headquarters in Baton Rouge. Wilson succeeds F. H. Lerch, Jr., and in his new position will also act as assistant to M. W. Bower, vice president of New Jersey Standard and general manager of the Baton Rouge refinery.

Stanley E. Slipper has been named supervisor of geological, geophysical, and drilling operations, chiefly in northern Alberta, for Algo-Canadian Oil Co.

Clay Briggs, chief engineer for Cities Service Co. who has been identified with the company's engineering and construction program since 1917, has been elected to the board of directors of the Delaware company. Briggs also is a member of the board of directors of Empire Pipeline Co.

E. F. Kindsvater has been named manager, and **P. M. Arnold,** assistant manager, of Phillips Petroleum Co.'s

E. F. KINDSVATER

P. M. ARNOLD

new chemical engineering department. The new department will handle operations now being carried out by personnel of the research and development departments. Kindsvater started development of the general engineering department's test division in 1931 and served as test engineer until 1940 when he became chief engineer. Arnold formerly was manager of the company's process engineering division of the chemical products department.

George Furnival of Calgary, petroleum engineer in charge of development work for California-Standard Oil Co. in Alberta, has been appointed director of lands and mines for the Manitoba provincial government.

Harold Keans, Union Oil Co. of California, has been transferred from Santa Fe Springs, Calif., to Long Beach where he is now production foreman for that field and Huntington Beach.

Lloyd F. Bayer, vice president and a director of Tide Water Associated Oil Co., has received the Stevens Honor Award Medallion for Notable Achievement from Stevens Institute of Technology. Bayer graduated from the Institute in 1914, receiving a degree in mechanical engineering. He joined Tide Water Associated in 1916 and is chairman of the operating committee of the western division with headquarters in San Francisco.

Dr. William J. Sparks has been named associate director, and **Dr. Byron M. Vanderbilt,** assistant director of the chemical division of Standard Oil Development Co.

H. L. Rowley, member of the partnership comprising Big Chief Drilling Co., has taken charge of a new office which the company has opened at Shreveport.

E. G. Adlong has been named foreman of the light oil department of the Baytown refinery of Humble Oil & Gas Co. succeeding **R. W. Richardson,** who retired.

J. Grant Spratt, vice president and general manager of Anglo-Canadian Oil Co. of Calgary, has been made managing director. Spratt joined Anglo-American in 1940 as assistant manager.

E. Q. Beckwith, Hugh A. Neal, and **Doyle D. Buttolph** have rejoined Phillips Petroleum Co. in the chemical products and chemical engineering departments after service in the Army. Beckwith, manager of product supply division of the chemical products department in Bartlesville, was at the time of his separation chief of the production service branch of the Army's Cleveland Ordnance district, with the rank of major. Neal returned to the company as

E. Q. BECKWITH

HUGH A. NEAL

D. D. BUTTOLPH

assistant manager, Perco division, chemical products department, after

one of the longest leaves in the Phillips organization. He entered the Army in September 1940, was wounded in Italy and released as a lieutenant colonel after duty at the Field Artillery School at Fort Sill. Buttolph, assistant manager of the mechanical equipment division, chemical engineering department, spent 4 years in the Army, at one time doing research on vehicles at the Aberdeen Proving Grounds. He was separated a captain.

C. R. Allen, division production superintendent for Continental Oil Co., has been transferred to Ponca City with the closing of the division office at Evansville, Ind. **George Taylor,** geologist, and **Earl Wooldridge,** landman, are remaining in Evansville.

T. E. Swigart, president of Shell Pipe Line Corp., has been elected president of the Community Chest and Council of Houston and Harris County.

Edward J. Pierce, recently released from military service, has returned to Mid-Continent Petroleum Corp. as petroleum engineer in the West Texas district with headquarters in Midland.

Edward L. Patton, back after 5 years in the Navy, and **Frank T. Waltermire,** former lieutenant colonel in the Army Ordnance Department, have rejoined the Louisiana Division of Standard Oil Co. of New Jersey as process engineers, Patton in design and Waltermire in the economics section.

M. K. Dixon, formerly of Dayton, Ohio, has joined Cities Service Gas Co. as rate engineer in Oklahoma City.

W. T. Holliday, president of Standard Oil Co. of Ohio, has been elected to the board of directors of Brand Names Research Foundation, Inc., a nonprofit organization which studies the brand-name system of goods and services distribution.

A. B. Barrow, engineer and oil operator, has reopened his office at Evansville, Ind., after 4 years in the Army.

J. A. Smith has rejoined Ashland Oil & Refining Co. as landman at Evansville, Ind., after 51 months in the Army from which he was separated as a major.

O. C. Harper, independent operator, has been elected president of the Midland, Tex., Chamber of Commerce.

W. S. Zehrung, Pennzoil Co., has been reelected chairman of the general and the executive committees of the Associated Petroleum Industries of Pennsylvania. **Wayne C. Yeager,** Atlantic Refining Co., was named vice chairman of the two committees.

W. D. Anderson, formerly Permian Basin geologist for Amerada Petroleum Corp., has become a consulting geologist in Midland, Tex.

R. W. Parker has been appointed chief engineer of the manufacturing department of Standard Oil Co. of California.

Paul E. Brooke, formerly of Tulsa, is now head of the land department in the West Texas-New Mexico area for Sinclair Prairie Oil Co. with offices in Fort Worth.

Ernest H. Smith, former drilling superintendent for South Mediterranean Oilfields, Ltd. (Standard of California group), Cairo, will leave New York soon on a foreign assignment for Socony-Vacuum Oil Co., Inc.

C. R. B. Hopper, engineer for Bahrein Petroleum Co., is spending several months in California oil fields studying drilling and production methods.

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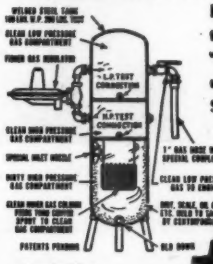

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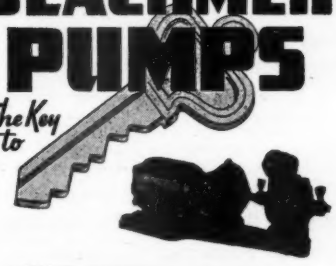

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Equipment Men in the News

Timken Names Division Manager, And Sales Engineer

Fred Reiser, Jr., Cincinnati district manager for the industrial division of the Timken Roller Bearing Co. since 1944, has

FRED REISER, JR.

H. McCOOL

been named division manager for all divisions, including industrial, steel, automotive, and service-sales.

Harry McCool, who joined Timken in 1928 as a hot mill operator, has been appointed sales engineer for the steel and tube division in Cincinnati district, which includes Indiana, Kentucky and part of Ohio.

Brown & Root Announce New Division

Brown & Root, Inc., announce the creation of a petroleum and chemical division, specializing in the design, engineering and construction of process plants for the oil, gas, and chemical industries.

Offices will be located at the Greens Bayou plant of Brown Shipbuilding Co., Inc. Milton H. Roths will be manager of the new division.

Ross New Republic Supply Store Manager at Kilgore

C. E. (Gene) Ross has been appointed store manager at Kilgore, Tex., for Republic Supply Co. He replaces H. T. Hopkins who was recently promoted to assistant district manager of the Shreveport district.

Oilwell Supply Co. Announces Several Personnel Changes

The following appointments have been made by Oilwell Supply Co., Dallas, a subsidiary of United States Steel Corp.:

Ben H. Ravanell as Rocky Mountain division engineer, and A. D. Otto as office manager for the same division, with headquarters in Denver.

D. L. Collins as manager of machinery sales, Gulf Coast division, and J. F. Barling as office manager, with headquarters in Houston.

James A. Hill as manager of the newly created Colorado-Wyoming district office at Casper, Wyo.

A. S. Finefrock as manager of the newly created Montana district office at Great Falls.

S. T. Lutz as manager of the Wichita sales office.

R. H. Christy as Central Midwest division office manager, John S. Fuller as Central Midwest division engineer, and R. T. Shoemaker as manager of subsurface department, Central Midwest division, with offices in Dallas.

J. A. Teter as Mid-Continent division office manager, G. I. Wyckoff as Mid-Continent division engineer, and J. P. O'Toole as manager, subsurface department, Mid-Continent division, with offices in Tulsa.

Funderburg Made Vice President Of Universal Atlas Cement Co.

Louis M. Funderburg, general operating manager, has been elected vice president of Universal Atlas Cement Co. and will be in charge of manufacturing operations for this U. S. Steel Corp. subsidiary.

National Aluminate Corp. Names Ryznar Research Director

John W. Ryznar has been made director of research by National Aluminate Corp., Chicago. He will be in charge of all research pertaining to both the railway and industrial divisions and will head the bacteriological department of the industrial division. Arthur L. Jacoby has been named assistant director of research, being promoted from his previous post as chief organic chemist. Raymond Reuter has joined the staff of Chicago Chemical Co., subsidiary of National Aluminate Corp., as sales and technical representative.

Bethlehem Opens New Store

Bethlehem Supply Co. announces the opening of its first new store for 1946 at El Dorado, Kans. F. W. Jensen, who just recently joined the Bethlehem organization, will be store manager and field representative. R. A. Johnson, district manager for Kansas, has his offices at 523 Union National Bank Building, Wichita, Kans.

Coleman Instrument & Mfg. Co. Named Distributor

Coleman Instrument & Manufacturing Co., 716 South Troost, Tulsa, has been appointed distributor for the Onan & Sons electric generating plants and the Construction Machinery Co. line of centrifugal pumps.

The distributorship permits sales by the Coleman organization in the following fields: Geophysical, marketing, general industry, aviation, and utilities.

Changes Announced in Taylor Sales Organization

Taylor Instrument Companies have just announced the following changes in the personnel of the sales organization:

J. E. Hart, formerly of the Taylor organization at Rochester and for the past 2 years deputy chief of the industrial instrument branch of War Production Board, has returned as manager of the Boston sales office from which point the New England territory is covered.

R. E. Flikkema, for 20 years manager of the Pittsburgh office, was transferred to Tulsa to take charge of that branch. With him is A. R. Wagner, who joined Taylors in the spring and who has had considerable experience in the oil industry throughout the Southwest.

Following the departure of Flikkema from Pittsburgh, F. C. Fuzzard, who worked with Flikkema several years, was made acting manager of the Pittsburgh territory. A. C. Mahana, of Rochester, is assisting Fuzzard in that territory.

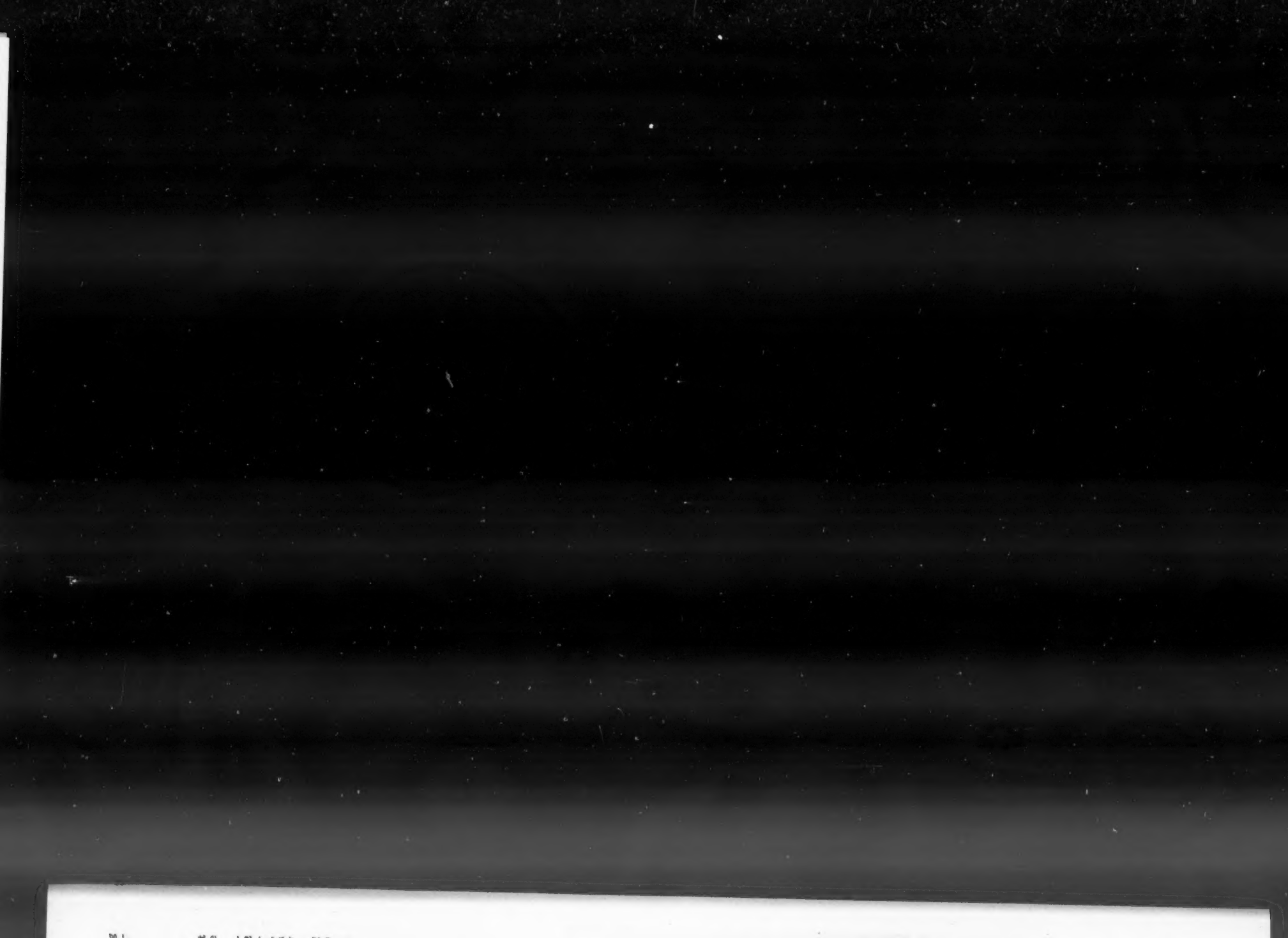
J. A. Grant, who started in the Philadelphia office nearly 10 years ago and was later in charge of sales activities centered in Greenville, N. C., has returned to Philadelphia to be part of that sales organization.

Wherritt Heads New Division For Aireon Manufacturing

J. M. Wherritt has been named manager of the new emergency communications division of Aireon Manufacturing Corp., according to R. C. Walker, president. He joined Aireon after 14 years with the Missouri State Highway Patrol where he headed the communication division.

Wherritt has been editor of the monthly magazine, "Associated Police Communication Officers Bulletin," for the past 7 years.

Earl Rees Joins Patterson-Ballagh

Patterson-Ballagh recently announced the association of Earl Rees with the firm. He will represent the company throughout California, and will make his headquarters at Los Angeles.

Newly elected officers of the Los Angeles Nomads in their first group photograph at the chapter's seventh annual inaugural dinner dance at the Biltmore Hotel, February 16. Front row: Roland Smith, export representative, regent; James V. Robinson, Miller Robinson Co., vice president; W. F. Bettis, M. O. Johnston Oil Field Service Corp., president; Ted Sutter, Baker Oil Tools, Inc., regent. Standing: Tom Martin, Eastman Oil Well Survey Co., assistant treasurer; Wallace A. Sawdon, Petroleo, sergeant-at-arms; William McGraw, Western Pipe & Steel Co., treasurer; Earle Daniels, Hydril Co., secretary, and Dan Duncan, Emsco Derrick & Equipment Co., deputy sergeant-at-arms